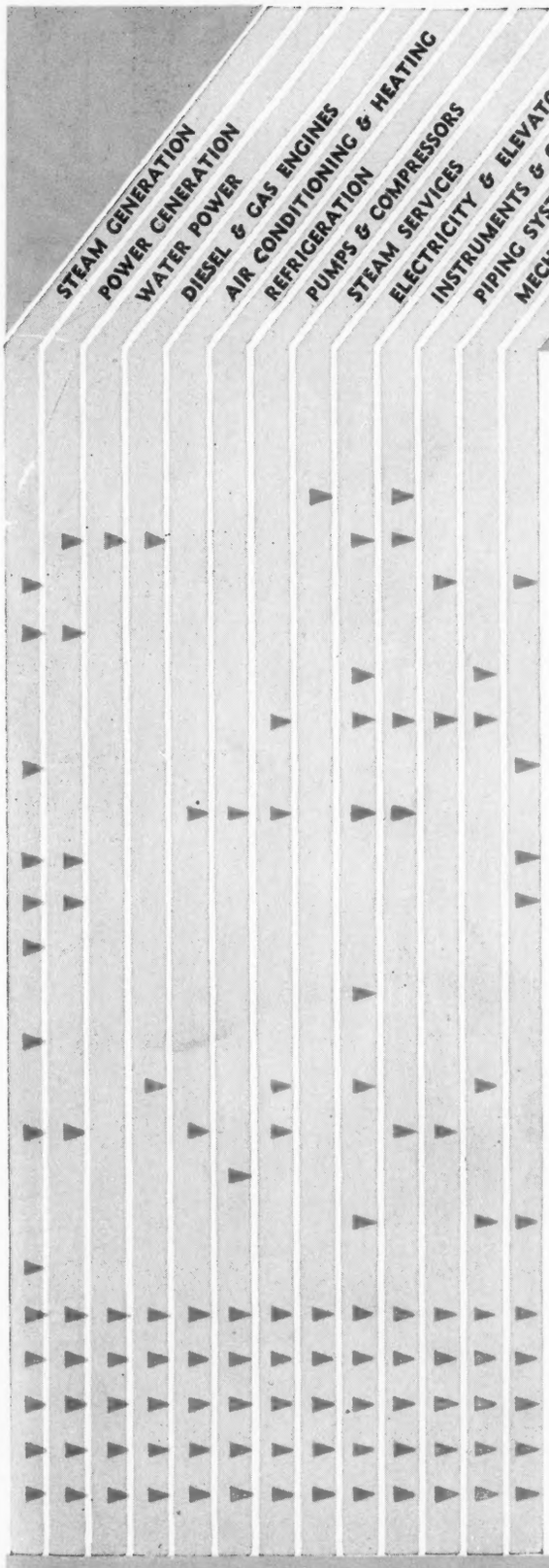

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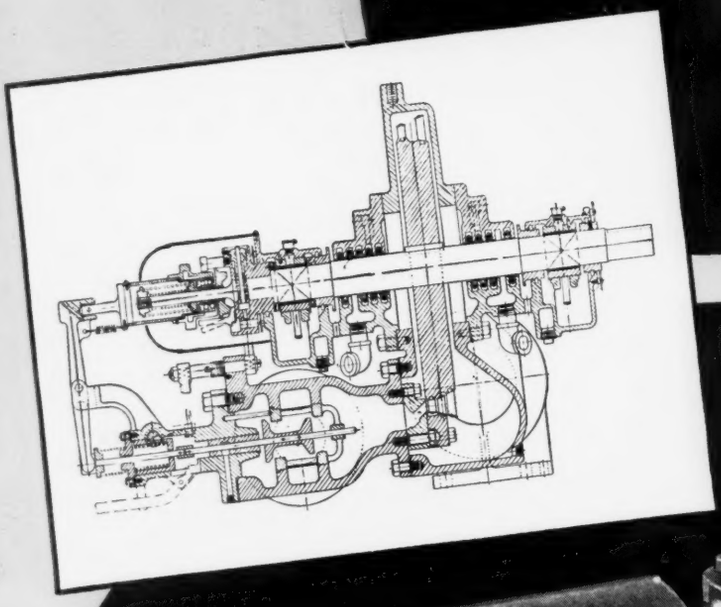
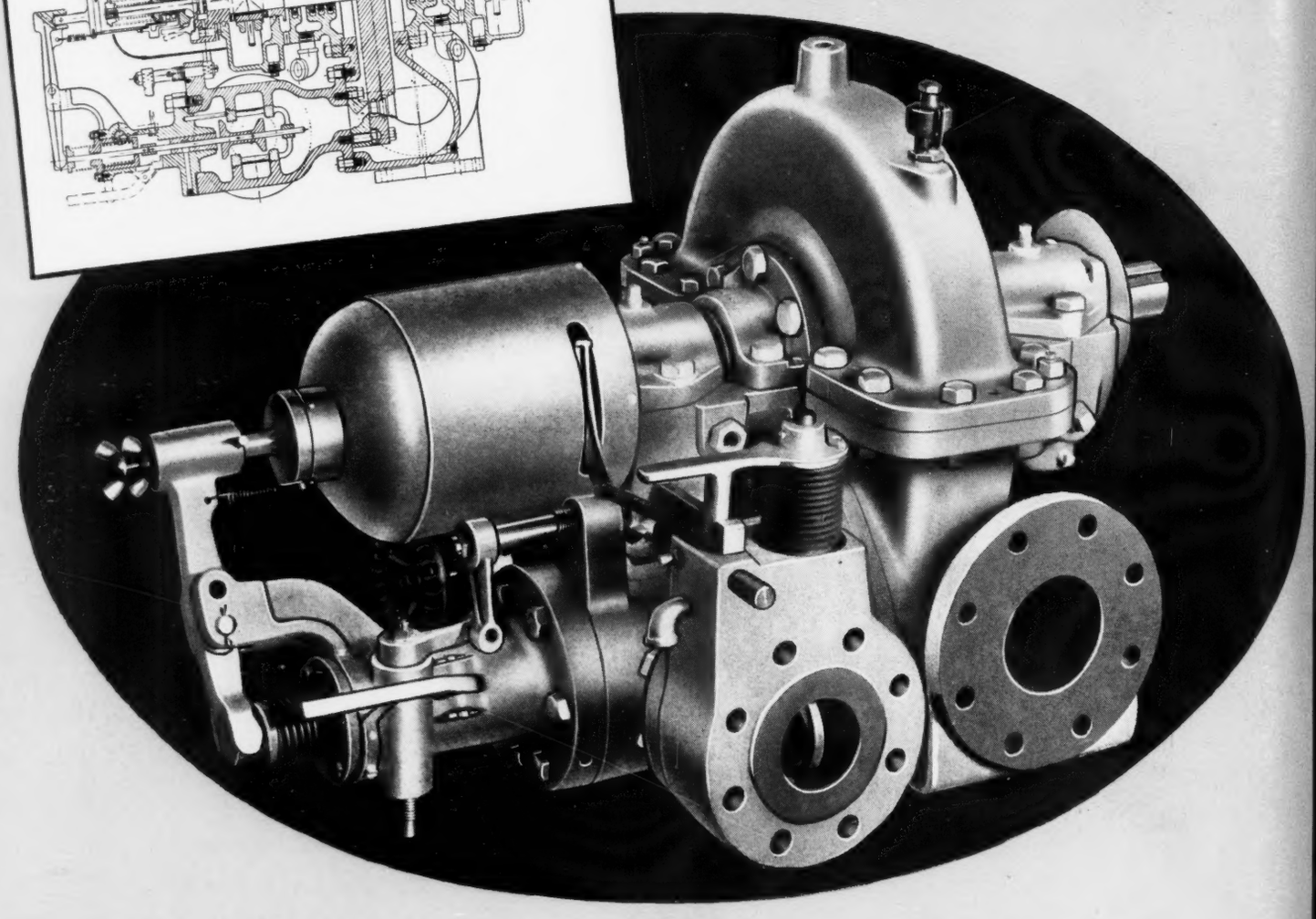
STEAM

TO HANDLE YOUR

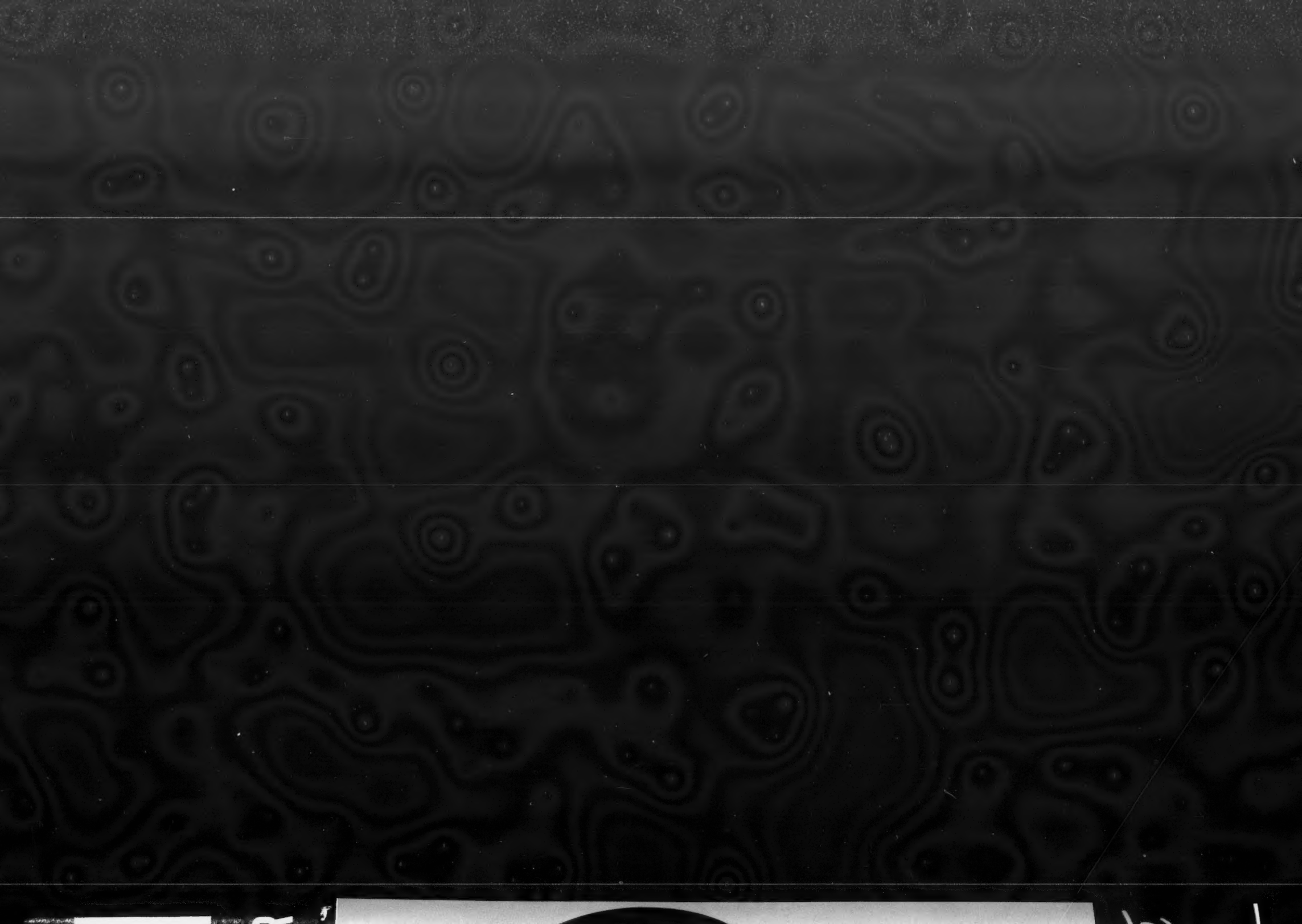




This is a typical Type C single-stage turbine—a member of a well-rounded line designed for reliability in general purpose service. It can be modified to suit any application by the addition of standardized parts. It is equipped with the new Westinghouse Dual Protection against overspeeding—a feature that safeguards the turbine and driven machine by simultaneously tripping both the governor valve and an independent butterfly valve.

There are many hundreds of type C turbines in daily service—doubtless some are near you, and can be conveniently visited and inspected. They set the recognized standard for steam drive mechanical power, from 5 to 1500 hp for driving pumps, fans, blowers, compressors, refrigerating, papermaking, generators and other machinery.

Westinghouse *Complete*



POWER

Established 1882 PHILIP W SWAIN, Editor

Utility Plant Trends

Utility plant construction runs in cycles—some years up, some down. We are now experiencing a wave of construction that will carry through 1940 and probably 1941 as well. This is one of those periods when the thinking of yesterday is translated into steel and brick—when ideas become facts.

In 1939 more than a million and a half kilowatts of turbine-generating capacity were ordered by the utilities, and at least another quarter million by industrials. With these went corresponding orders for steam-generating capacity, plus much additional boiler capacity for purposes other than prime-mover operation.

All of the new utility capacity is now "in the works"—some on the drawing board, some in the shops, some already on the job. In addition, numerous units ordered in 1938 are now nearing completion in these same shops, while others are being installed in plants.

Regardless of this year's new orders (which should be substantial, and will be reflected in the construction of 1941 and 1942), 1940 will be an important power year from the standpoint of equipment manufacture and plant construction—hence an important opportunity to study significant trends.

What are these trends, as revealed by an analysis of projects under way? First, it is clear that most of the new tops and condensing units will operate around 1200 lb and 900 F in cases where the new units represent only a modest addition to the existing system capacity and can therefore be assured of operation at high load factor. These heavy-use additions will justify 1200-lb pressure because their cost will be little more than for lower pressures, and because most of the troublesome problems associated with high pressures and temperatures have been solved, or practically so. These include the problems of turbine blading, pipe welding, feedwater preparation and treatment.

It would be a mistake, however, to conclude that the "trend" is towards 1200 lb and 900 F. Where the new capacity is a substantial fraction of system capacity, and therefore cannot be assigned exclusively to base-load operation, most designs favor steam conditions around 900 lb and 900 F, to save in first cost and to simplify design and operation. At modest load factors, these advantages outweigh the relatively slight fuel saving possible with 1200-lb operation.

It so happens that most of the smaller units ordered (15,000 to 40,000 kw) are for systems of moderate capacity. Here there is double reason to prefer 900 lb. First, the new capacity is a substantial fraction of the system capacity and therefore cannot operate at high load factor. Second, small turbines (for reasons of blade clearance, windage, etc) cannot translate higher pressure and temperature into fuel savings quite as effectively as can large machines.

Because the present wave of plant building presents an exceptional opportunity to take stock of trends, POWER presents, on page 64, a summary of the status and design features of many plants now under construction. Articles in succeeding issues will keep readers in close touch with further significant developments.

How To Get The Most Dollars

By PHIL SWAIN, *Editor*

▶ TOO FEW POWER-PLANT METERS and instruments are better than none at all. Elaborate metering equipment will often pay a handsome return, but we must face the fact that some plants, like some people, seem fated to go through life on a starvation diet. The one thing their engineers can't get, or think they can't get, is new equipment of any sort beyond what is absolutely necessary to keep the wheels turning.

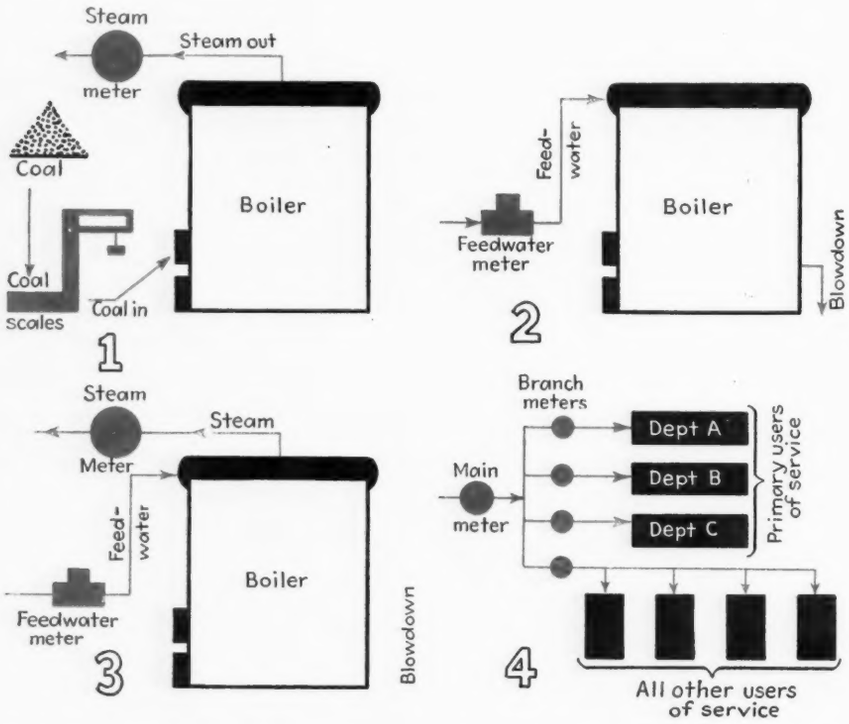
Every engineer knows scores of factories so poor they "can't afford" to operate at a profit. The chances are many of them could find the money if their managers honestly believed the promised savings were obtainable. Too often the real reason for inadequate equipment is a combination of suspicion and inertia, rather than actual poverty.

Let us assume that we have on our hands a very small institutional or industrial plant with one or two small boilers, no prime movers (electricity purchased), steam going to building heat in the winter and all the year round to water heating and a few process applications.

The boiler operates on natural draft. Coal, brought to the boiler front in a wheelbarrow, is dumped on the floor and shoveled in now and then when the spirit moves, or the fire gets too thin. What meters would you install in a plant like that? What meters would the manager of a plant like that be willing to pay for?

Let's start with the fundamentals. It is clear that the coal on the floor is a costly raw material, and that the steam generated is the only product, so costs at least as much as the coal.

The first need, therefore, is to measure the amount of steam produced and the amount of coal burned to produce it. Since the management will not approve costly methods, this essential information must be obtained with the smallest possible investment. We therefore recommend a small platform scale for coal, with a ramp so that each barrow load can be run up, weighed (minus tare) and tallied before it is dumped on the floor—primitive, but workable.



Basic boiler-plant accounting requires measuring coal burned and steam generated. Simple and direct way (Fig. 1) is platform scales for coal and meter for steam. But steam generated may be measured indirectly (Fig. 2) by feedwater meter (deduct blowdown). For a double check, it is safest and best (Fig. 3) to meter both water and steam. Good bookkeeping must cover distribution as well as generation. Main and branch meters for steam, electricity and water pay big dividends. Fig. 4 shows a sound set-up for a single service. Note that meters are so placed that sum of metered branch flows equals metered main flow. This permits checking meters. Note also that important consuming departments are separately metered

Measure the Steam

The next need is some cheap means of measuring the steam produced, either directly or indirectly. A steam meter would be most direct, but water is easier to measure. A venturi flowmeter, with recorder, will be the most dependable and convenient equipment for measuring the feedwater. If there is no money for that, we may have to compromise on a low-cost displacement meter somewhat like the one the boss has in his home.

This simple meter will measure the cubic feet of water fed to the boiler. To convert this to pounds multiply by the weight of one cubic foot at the existing temperature. To get the steam production (approximately), subtract the estimated blowdown from the feedwater measurement.

The operator has now the basic set-up for a simple record system—a foundation for important dollar savings. He is set to measure steam and coal, to figure his actual evaporation per pound of coal burned and see whether it compares reasonably with the performance of similar small plants burning the same coal.

Yet this simple measurement of the over-all result—evaporation per pound of coal—is not enough. It tells the operator whether he is doing well or badly, *but not why*. We must go a step or two further with this little plant before it can be said to be out of the pauper class as far as metering is concerned. We must install a few instruments and meters designed specifically to spot the major wastes in boiler operation. You might call them detectives.

No. 1 waste is that resulting from excess air. After you have supplied

From Your Metering Penny

enough air to burn the fuel completely, any additional air supply steals fuel dollars; it picks up part of the heat of combustion and carries it to waste up the stack.

The obvious cure for needless waste by excess air is to install some device to measure the excess, either directly or indirectly. This means putting in either a CO_2 recorder (since the percentage of excess air is directly related to the percentage of CO_2 in the flue gas), or a so-called steam-flow-air-flow meter.

The last-named device operates on the principle that, if the percentage of excess air is constant, the gas flow through the boiler will be proportionate to the steam flow through the header. This instrument has one recording pen for "air-flow" and another for steam-flow. The two rise and fall in unison as long as the percentage of excess air is kept constant.

Steam-Flow-Air-Flow

In practice, the instrument is first adjusted (with the aid of an orsat—a hand-operated device for analyzing flue gas) so that the air pen and the steam pen will stay together as long as the percentage of excess air is correct. If the pens pull apart, the fireman knows that he must immediately attend to his fire or his drafts to bring them together again. Incidentally, the steam-flow-air-flow-meter gives a direct measurement of steam flow, and thus covers the basic requirement for steam measurement, previously mentioned.

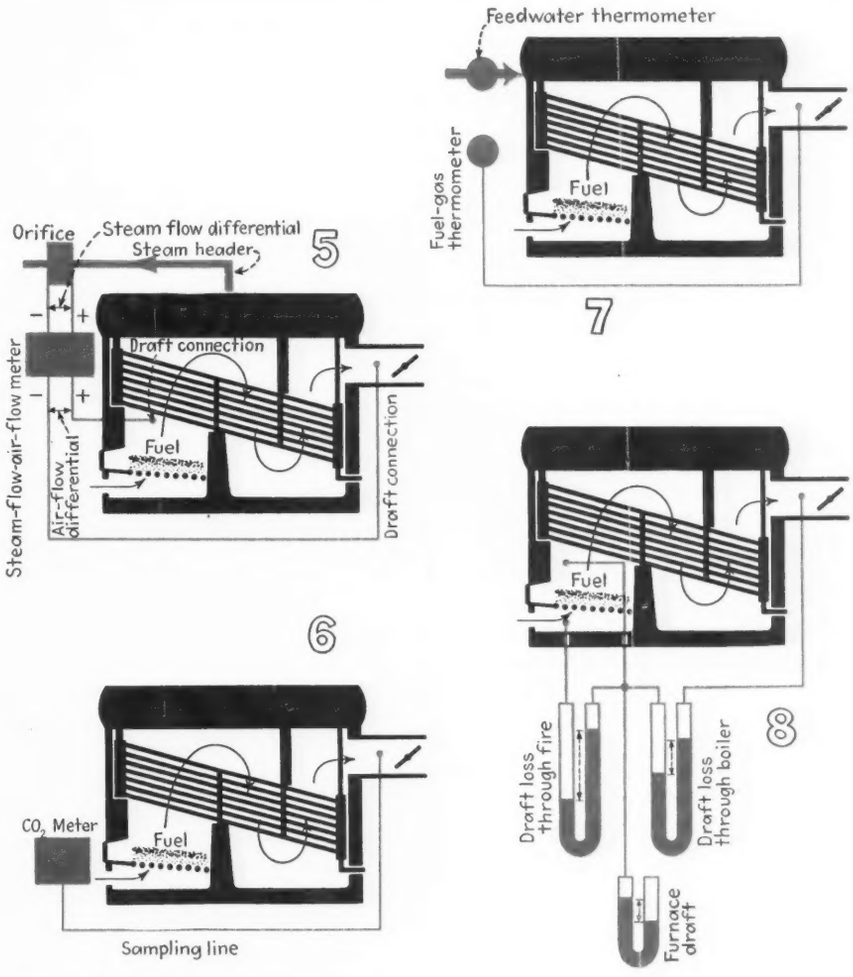
Reasonable minimum metering should include either a CO_2 recorder or a steam-flow-air-flow meter. Some engineers strongly favor one of these instruments, some the other. Either will effectively guide the fireman in excess-air control if kept in good operating condition and used intelligently.

But there still remain several untouched areas of guesswork. For example, what should be done if the excess air is too high? Some way must be found to spot the cause instantly, whether it be holes in the fire, leaks in the setting or a high suction (draft) in the furnace. Any of these will admit useless air to dilute and cool the products of combustion. With hand firing, draft gages are necessary to spot holes in the fire. Where draft fans are used draft gages are essential also to "balance" the furnace draft so that a minimum of cold air will be sucked in through setting leaks, door cracks and poke holes.

Efficient boiler operation is hardly possible without draft gages. Several will be needed to give the following either by direct reading, or by subtraction: Draft loss through the fuel bed, actual draft (suction) in the furnace, draft loss through the boiler. It will also be desirable to measure actual draft (suction) at the uptake.

Draft drop through the fire will quickly signal holes in the fire—also a fuel bed that is clogged, or too thick or too thin. The reading of furnace draft will permit such control of dampers and fans that flames won't rush out when the fireman opens the door, nor will cold air rush in to lower the efficiency.

Measurement of draft loss through the boiler will quickly show up the increased resistance caused by soot or ash



The bookkeeping meters show whether results are good or bad. These detective instruments show why and what to do about it. Unnecessary excess air, primary source of waste, is spotted by steam-flow-air-flow meter (Fig. 5) or a CO_2 instrument (Fig. 6). In Fig. 7 flue-gas thermometer detects interferences with heat transfer by scale, soot or leaky baffles, while feedwater thermometer shows whether heater is on the job. Draft gages (Fig. 8) are essential guides to efficient operation. Draft loss through fuel bed spots wrong thickness, clogging and holes. Draft loss through furnace signals soot and ash accumulation, also leaky baffles. With f-d fans, direct measurement of furnace draft permits balancing furnace pressure with atmospheric to reduce air infiltration

accumulations, or the decreased resistance from broken or leaky baffles.

This hypothetical small plant now has coal measurement, a meter for steam or feedwater (or both), a device to measure excess air and a battery of draft gages. With these meters and instruments, it has measured its overall performance and cut excess air down to a reasonable level. Is there any room to make other savings by meters or instruments?

The answer is "Yes, a flue-gas thermometer will save money." The loss in the gas going up the stack depends not only on the amount of such gas, but also on how hot it is. With a fixed percentage of excess air—that is, with excess air fully under control—stack temperature (and stack loss) may rise because leaky baffles, or accumulations of soot and scale, hinder the transfer of heat from gas to water. A flue-gas thermometer will immediately reflect these conditions. It may be of the simple bulb type, or preferably a recording instrument mounted for easy observation by the fireman.

Feedwater Temperature

Minimum metering must also provide for measuring the temperature of the feedwater. Every 10-deg rise in feedwater temperature saves approximately 1% of the coal. Simple bulb thermometers for both feedwater and flue temperature will pay their cost quickly in any plant, large or small.

The engineer now has a "minimum metering" set-up for his boiler room. It will enable him to make cheap steam, but not to prevent wasteful use of steam and other services. He must spot and stop wastes in the use of generated steam (for process and heating), and purchased electricity and water.

The first step is to meter the total of each service used. The boiler feedwater or steam meter already installed will give the total steam. Supply meters already installed will measure total water and total electricity.

In all but the smallest institutions and factories, there are several departments, each the responsibility of a different supervisor. Some or all of these departments use steam, electricity and water in substantial amounts. If these independent operations draw their power services from a common pool and are not independently charged for what they actually use, the department heads have little incentive to save. The only way to cut service waste is to install an independent meter for each service to each department making important use of that service.

Where there may be some argument as to the value of distribution meters, it is well to start with those that will make the largest savings per dollar invested. In a hospital, for example, start by putting a separate meter on the water going to the laundry. This is probably the biggest single sore spot in the establishment.

For a plant short on investment cash, one might say that the minimum distribution metering is that which will pay a handsome return (say, 30% or more yearly) on the meter cost. Just what meters will pay that return in a given establishment can be easily determined if you feel your way gradually into departmental metering along the lines indicated.

A big book of detective stories could be written from the experience of meter users. Here's an example from a POWER reader in New England:

"About a year ago, on a Monday, I noticed that the amount of feedwater exceeded the amount of steam delivered considerably more than usual. The meters were checked and found to be OK. We hunted for a few days and could not find anything wrong until we opened the front door of the boiler over the week-end. Then we discovered that the tubes were not only leaking, they were running in a stream, but there was no outside indication that this was the case, because we had opened the back door during our investigation and could not hear the slightest noise. The loss was about 2000 gal per day, but since the boiler was in operation the water just evaporated.

This engineer's plant is fairly small, although larger than the one we have been talking about. His practices go well beyond the bare minimum of metering, and he finds it pays him well. Many of his meters record directly in his office. During the daytime their charts keep him in touch with what is going on. And when he comes to work in the morning he learns a lot about last night's operations. A sample, with tags, is shown in Fig. 9.

We must not finish without one reminder. Meters are put in for two purposes only. One is to reduce the overall cost of operating the factory or the establishment. The other is to permit accurate costing of manufactured articles for pricing purposes. The momentary readings of instruments and meters help keep down costs, because they show the operators how to correct wrong conditions as soon as they occur. But they do this only because they know there will be a final check-up at the end of the day or month.

This check-up, which means record-keeping and cost-keeping, is essential to the best results. In the case of distribution meters it is the only possible way of getting out their value. The distribution philosophy of the wise engineer is: "Charge it and they won't waste it."

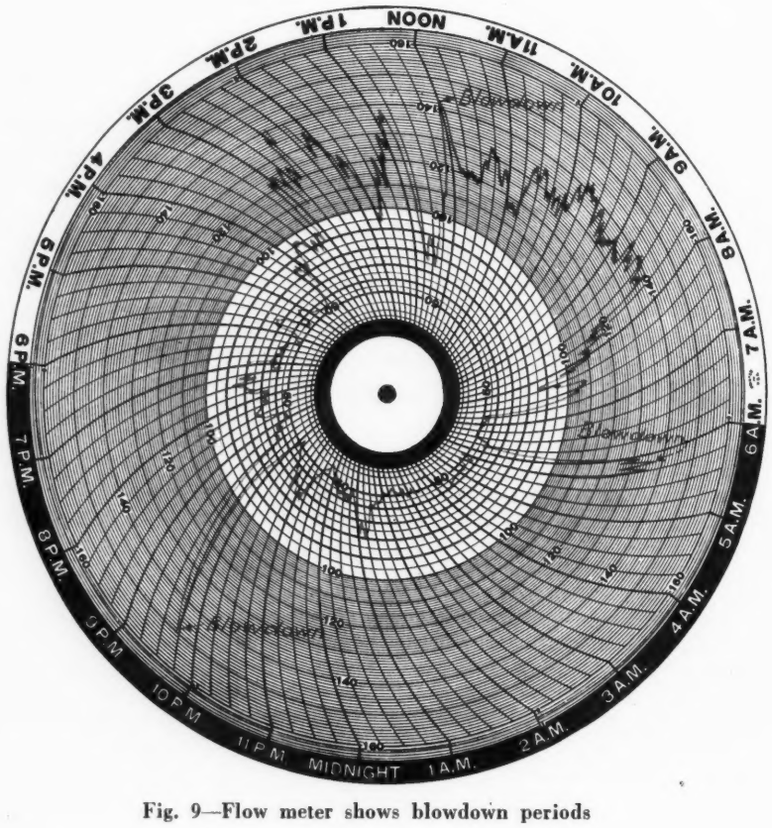
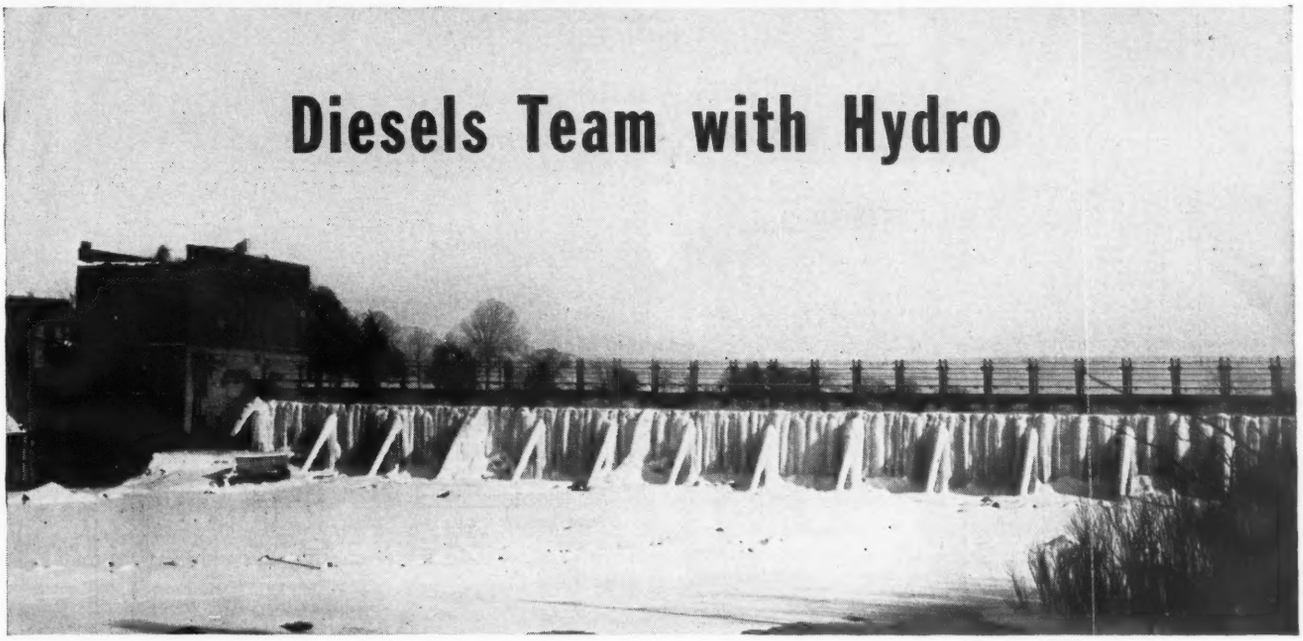


Fig. 9—Flow meter shows blowdown periods

Diesels Team with Hydro



New diesel generating unit, rejuvenated hydro turbines, modernized electrical equipment and reinforced distribution system step up service for Sturgis, Michigan

▶ FIFTY YEARS AGO Sturgis, Mich., began furnishing electric service from its own plant, making it one of the oldest municipal electric systems in the state. Sound management produced an impressive record of earnings; substantial cash grants and contributions from profits have financed a great variety of municipal improvements and materially reduced the tax rate. The confidence and goodwill of the community was demonstrated when, in the fall of 1938, it became necessary to vote bonds to finance the City's share of a PWA project to make needed improvements and additions to the system totalling $274,000. A vote of 1005 to 217 authorized $150,700 of serial utility-revenue bonds, which were sold at 2.16%, with a small premium. The balance of the funds required came as a grant from the federal government.

Before work began on the current project, the municipal system consisted of: (1) A reinforced-concrete multiple-arch dam and spillway on the St Joseph River about 18 miles from the city (built in 1911), providing head for two hydro units of 550-kva each and a 40-kw turbine-driven exciter unit. From a 2400-volt switch structure and board, current stepped-up in six 200-kva, 2400/24,000-volt, single-phase transformers. (2) A 24,000-volt transmission line (three No. 4 cables carried on wooden poles) which connected to a city substation consisting of six 200-kva, 24,000/2400-volt transformers, housed in the diesel-electric-plant building in the city. (3) A diesel generating plant (built in 1936) comprising two 600-kw engines, generators and accessories, and also storm-water pumps and other equipment. (4) An electrical-distribution system with 2400-volt primaries and 240—120-volt secondaries.

The new project included addition of diesel generating capacity and general diesel-plant improvements, rejuvenation of hydro equipment and modernization of electrical equipment, reinforcement and improvement of the distribution system. Completion of this work puts the Sturgis system in first-class condition, ready for future load growth.

CONSTRUCTION CONTRACTS

Distribution system changes and additions $22,800.00
George S Schugman, Abingdon, Ill.
Diesel-engine and accessory equipment $151,900.00
Busch Sulzer Bros-Diesel Engine Co, St Louis, Mo.
Engine ..... Busch-Sulzer Bros-Diesel Engine Co
Generator, exciter ..... Westinghouse Electric & Mfg Co
Cooling tower ..... Schubert-Christy Corp
Cooling-water pumps ..... Dayton-Dowd Co
Heat exchangers ..... Ross Heater & Mfg Co
Exhaust snubber ..... Burgess Battery Co
Oil filter ..... Hilliard Corp
Air filter ..... American Air Filter Co
Water-turbine replacements and repairs $12,950.00
Allis-Chalmers Mfg Co, Milwaukee, Wis..
Power transformers $10,050.00
Turner Electric Co, Detroit, Mich., representing Standard Transformer Co, Warren, O.
Electrical work at both plants $33,000.00
Koontz-Wagner Electric Co, South Bend, Ind. (G E switchgear)
Building Changes $11,900.00
Pearson Construction Co, Benton Harbor, Mich.
(Crane furnished by Kalamazoo Machine & Foundry Co)

New Diesel Unit

First step in the program was the purchase of a new diesel generating unit. Although the existing diesel plant was but three years old, and housed two modern machines, increasing load made it necessary to add more capacity and a third unit of about 1600 kw was proposed. On the basis of bids received in January, 1939, contract for the engine and accessories went to Busch-Sulzer Bros-Diesel Engine Co, makers of the city's two previous diesel units. The contract called for an 8-cyl, 19.5 x 27-in., 240-rpm, 2-cycle engine, with 1080-fpm

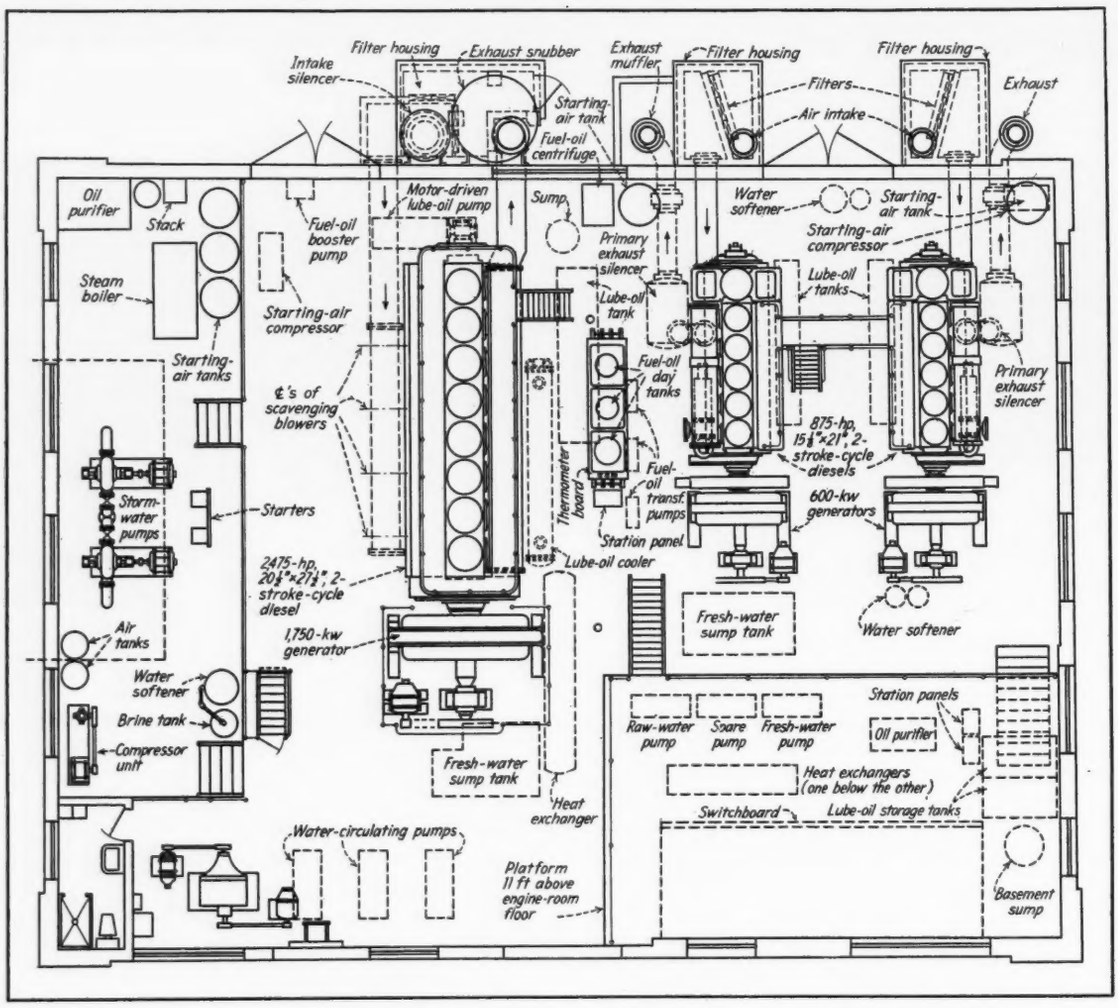


Fig. 1—Plan of diesel plant shows new 1750-kw unit and auxiliaries

piston speed and 61.4-lb-per-sq-in. brake-mean-effective pressure, driving a 1700-kw, 0.8-pf generator. However, the contractor had on order several engines of somewhat larger size and so could offer, without additional expense to the city, a 20.5 x 27.5-in. engine, with 1100-fpm piston speed and 56.25-lb bmep, driving a 1750-kw generator. Naturally, the city accepted this offer.

Moving the six 200-kva transformers connecting to the transmission line, and the transformer switch structure, made room for the new engine, see Fig. 1. A new bank of three 500-kva, single-phase, 24,000/2400-volt transformers was placed on a concrete mat outside the building, with a steel structure to carry buses, disconnects, lightning arresters and miscellaneous equipment. After this installation was completed and connected to the switchboard, the old 200-kva transformers were removed and work started on engine foundation.

Adding the new engine involved only minor changes in the superstructure, but required construction of a new basement. As can be seen from the plan, Fig. 1, most of the engine auxiliaries fit into this new basement space, with intake-air filters and exhaust snubber outside the building at the rear (Fig. 3). Removing the storm-water pumping equipment at the end of the building will make space for another unit similar to that just installed.

Fig. 2 shows the operating side of the new trunk-piston, port-scavenging and port-exhausting engine, with Woodward governor and injection system having Deco fuel valves and Busch-Sulzer fuel pumps. The control panel at the right carries, on its ebony-asbestos front, lubricating-oil, jacket-water, and starting-air low-pressure alarms and jacket-water high-temperature alarm with indicating lights; Alnor exhaust pyrometer and selector switch; pushbutton controls and indicating lights for raw- and fresh-water pumps and spare water pump, lubricating-oil priming pump, two cooling-tower fans, and fuel-oil booster pump. Pushbutton stations near starters provide for operation of pumps and other auxiliaries at points near the individual pieces of equipment. A new generator panel, regulator panel, and feeder panel were added to the main switchboard and changes were made in the arrangement of other feeder panels and switchboard accessories.

Early operation shows the new engine to be highly satisfactory, and loads up to 2000 kw have been carried successfully. This new unit makes the total available capacity adequate for some time to come and since building changes were made with the idea of providing for the installation of a similar future unit at minimum cost, the diesel plant is ready for any development.

A new induced-draft, heavy-duty Schubert-Christy cooling tower to handle jacket-water cooling for all three engines is an important part of the plant expansion. The new tower has two cells, 12 ft long, 18 ft wide, and 28 ft high, each equipped with a 103-in. diameter, 6-blade, adjustable-pitch, aluminum-alloy airfoil fan, driven by a 7.5-hp, 1160/290-rpm gearmotor. Asbestos-lumber paneling covers the all-heart California redwood tower framing. This unit can cool 850 gpm from 115 F to 85 F with air having a wet-bulb temperature of 75 F.

The new tower rests on the concrete

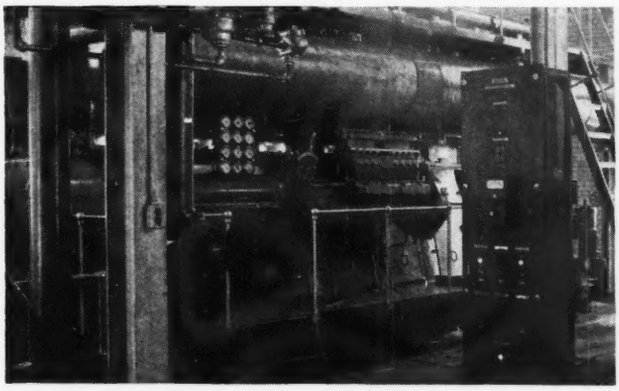


Fig. 2—Operating side of new engine and instrument panel

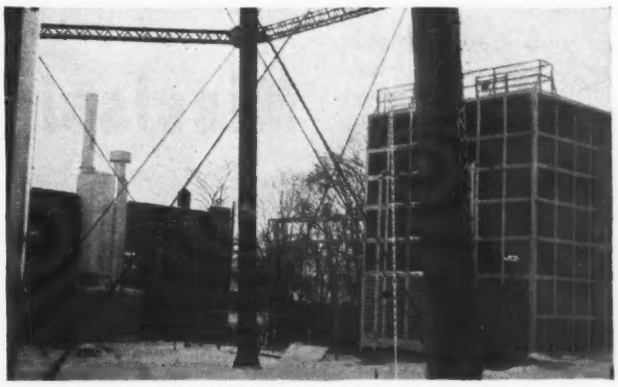


Fig. 3—New exhaust snubber, air filters and cooling tower

basin formerly used for an atmospheric tower taking care of the two 600-kw engines. The new unit was erected on the space immediately adjoining the old tower; the old unit was dismantled and the new tower was moved over onto the old basin, thus maintaining service with a minimum of interruption.

Work now in progress will rejuvenate the hydro plant, improving its efficiency and reliability. Turbine runners of the hydraulic generating units had been badly pitted in 25 years of service, and other turbine parts and accessories needed repairs and replacements. Operation of the new diesel unit permits the Allis-Chalmers Mfg Co, makers of the original turbines, to take these units out of service, one at a time. The greater efficiency of the modern runners will, it is expected, pay for the entire cost of the work over a reasonable period of time. New trash racks in the wheel pits upstream from the turbines replace old rusted and weakened racks.

Rewinding the generators will eliminate trouble from seriously weakened insulation. This work is included in a general contract for all electrical work at both hydro and diesel plants. The generators will be rewound while turbine work is under way, so that only one unit will be out of service at a time. Additional electrical work includes removal of the six 200-kva transformers from the building; these are being replaced with three 500-kva units similar to those installed at the diesel plant, thus keeping all high-tension equipment outside the building and increasing safety. Old open-type 2400-volt switch structure and switchboard will be replaced by metal-clad units.

Extensions and additions to the distribution system had been made over many years and although the system was in reasonably good condition, the primary circuits and many secondary lines had become inadequate for the increased load. New primary feeder circuits of No. 2/0 wire in the southern and northern part of the city, connected at various points to existing feeder circuits, and replacement of conductors in other primary circuits, with cable of larger size, produced a main primary system of considerably increased capacity, improving voltage and decreasing power losses. Disconnects at various points permit sectionalizing parts of the system and the two new feeder circuits are so situated that they can be connected together at various points in the city, thus providing considerable flexibility in operation.

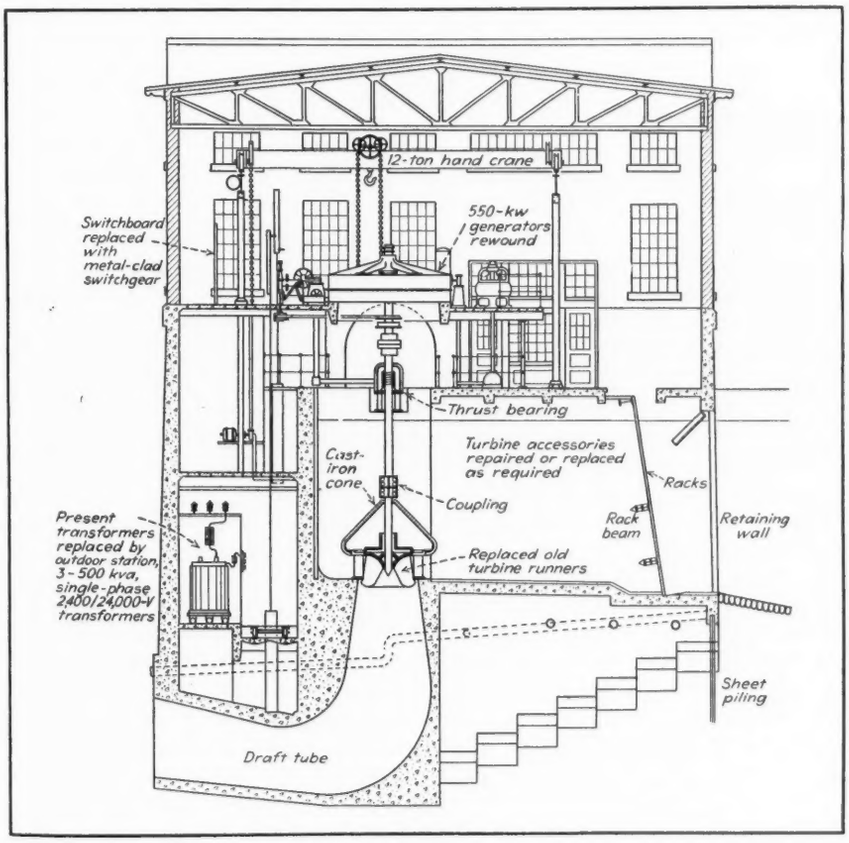


Fig. 4—Cross-section of hydro plant indicating location and extent of replacements

Power Lines Moved

Certain primary and secondary lines were moved from existing locations where there had been tree difficulties or where unsightly appearance had proved objectionable. New secondary lines were constructed at several locations and conductors of other secondaries increased in size where load growth had overburdened old conductors.

Ayres, Lewis, Norris and May, of Ann Arbor, Mich., consulting engineers for the city on all the work, prepared plans and specifications and furnished general and resident supervision of construction. City officials devoting considerable time to the project include Lloyd C Waterstraut, City Manager; Mayor Willard E Rupe and City Clerk S F Weatherwax, and for the cooperative efforts of these and other City officials much credit is due. J J Threlfall is Chief Engineer.

Mississippi Makeup

Louisiana Station of Gulf States Utilities Co installs unusual storage and materials-handling system for large quantity of chemicals required to treat turbid river water

By AUGUST C KLEIN
Chief Mechanical Engineer
Stone & Webster Engineering Corp

▶ WITH THE GROWING USE of high steam temperatures and pressures in modern boilers of high capacity, it has become increasingly important that boiler feedwater be uniformly conditioned to prevent scale deposition on, and the corrosion of, surfaces with which it comes in contact.

In condensing power plants, only a small amount of raw water is required and the plant can economically use water of high purity from city mains or from evaporators. Its chemical conditioning processes are confined primarily to maintaining boiler water in proper condition. The moderate quantity of chemicals needed can be received and stored in barrels, bags or other containers at a reasonably low total cost and mixed in small batches as required.

In plants that deliver large quantities of process steam and in which there is little or no recovery of condensate, it is necessary to treat extensively practically all of the feedwater, and the larger chemical consumption warrants special attention to receiving, storing and handling chemicals.

Table I compares the chemical requirements for Louisiana Station with those of Williamsburg in Brooklyn, New York. Both are recently constructed plants of about 100,000-kw capacity.

High Percent Makeup

The Williamsburg Power Plant Extension is typical of modern high-pressure condensing power plants. The Louisiana Station is a high makeup plant delivering about 70% of the steam it generates to industrial customers. The latter plant takes its water directly from the Mississippi River, which is turbid at all times and which varies materially in its content of dissolved solids. Originally placed in operation in 1930, the plant was extended in 1938 and can now treat 5000 gpm of raw water.

In the design of the 1938 plant extension particular attention was given to methods of receiving, storing and handling chemicals. At the outset the designers fixed as their objectives: (1) the purchase of all important chemicals in bulk, (2) sufficient storage to permit purchases in car-load lots, (3) subsequent handling to be entirely mechanized, (4) chemical quantities constantly proportioned to the water being treated.

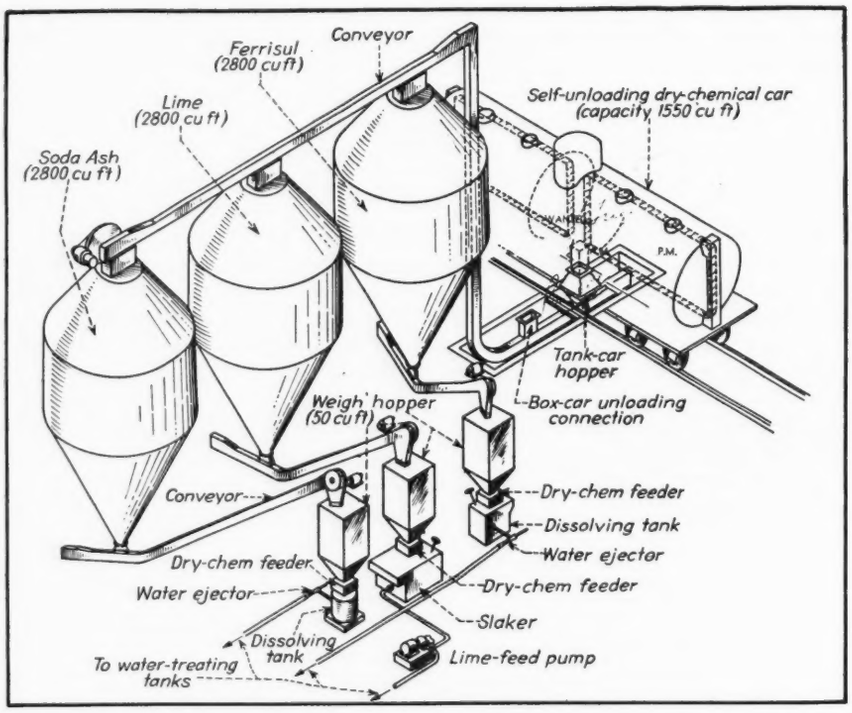


Fig. 1—Isometric sketch of chemical storage and handling equipment in which all operations are mechanical from self-unloading tank car to solution piping

The new chemical-handling plant meets all these objectives. It includes provision for storing and handling sulphuric acid in concentrated form, and salt and caustic soda in the form of brine. Sulphuric acid is received in tank cars, unloaded by compressed air, and stored in an overhead steel tank. Salt is obtained in the form of 80% saturated brine by a pipeline from an adjacent chemical plant, is stored in basins, filtered and passed through a salt bed to bring it up to full saturation before use in regenerating the zeolite softeners. Caustic soda is received in 50% concentrated form in tank cars and unloaded to a heated storage tank by compressed air.

Provision has been made to receive the other principal chemicals, unslaked lime, Ferrisul, and soda ash, in dry form in either standard box-cars or in self-unloading tank cars.

While caustic soda and soda ash are used interchangeably to produce alkalinity, either can be handled in bulk, thus permitting the plant to purchase the more economical of the two chemicals; at present this is caustic soda.

Fig. 1 is an isometric drawing of the Louisiana Station dry-chemical-handling apparatus. At the right is a phantom view of a self-unloading tank

car. This car is similar to the tank cars in general use for transporting liquids but its interior is equipped with two continuous motor-driven chain conveyors. These conveyors drag chemicals to an unloading well in the center of the bottom of the car. The car also has several top openings through which chemicals can flow to fill it completely.

In tests made previous to the adoption of tank cars for supplying Louisiana Station, it was found that the internal conveyors unload the tank car satisfactorily, leaving only a negligible amount of material in the car. For unloading box cars a power shovel has been provided. It discharges chemicals into a special removable hopper at the car door connected to the same conveyor that has been provided for unloading tank cars. With this equipment it is possible to unload two to three cars in one 8-hr shift.

The continuous conveyor into which tank cars and box cars are unloaded is self-cleaning; this feature permits it to be used to handle alternately the different major dry chemicals used in the plant. The conveyor delivers the chemicals into their respective bins, each of which has a capacity of 2800 cu ft or about 1½ cars of material. All of this equipment is outdoors, special precautions having been taken to make all parts of it completely water-tight and dust-tight, since satisfactory handling and storage depend on keeping the materials completely dry.

The balance of the equipment, which includes the dry feeders, slaking and dissolving tanks, is housed in the chemical-control building.

Each storage tank is served by a continuous conveyor operated about once a shift to fill the 50-cu-ft weigh hopper of the corresponding dry feeder. The feeder operation is controlled automatically by proportioning equipment actuated by the quantity of raw water entering the treating plant. All water entering the treating plant flows through a single pipe, which contains a contact-making flowmeter. Every 15 seconds an electrical impulse is sent by the flowmeter to each of the three chemical feeders, where it causes a balance weight to be moved along the scale beam on the feeder weigh hopper.

The duration of each electrical impulse is proportional to the rate of water flowing through the meter, and inasmuch as the duration of the impulse determines the distance that the scale weight is moved, the quantity of chemicals that has to be discharged to balance the scale beams is maintained proportional to the water flow. When the scale-beam weights are moved the dry feeders are speeded up momentarily. As the chemicals are fed the scale beams return to balanced positions and the flow through the feeder mechanisms is slowed down or stopped until another impulse is received.

The dry chemicals are delivered into dissolving tanks directly under the individual feeders. Each of the three tanks has been specially designed and proportioned to the service required. The lime-dissolving tank is a combined slaker and dissolver. It receives dry unslaked lime in the slaking compartment and is supplied with a limited quantity of warm water in proportion of seven parts water to one part lime.

Secondary Dilution

A rich solution is produced which is later diluted in a second compartment of the dissolving tank. During the slaking and dissolving operations the mixture is kept constantly agitated by the action of high-speed, propeller-type mixers. Trash is hoed out periodically while the slaker is in service.

The process of dissolving Ferrisul is likewise accomplished in two steps, in the first of which the dry material forms a rich solution by the addition of four parts water per part of Ferrisul while solution temperature is maintained at about 120 deg F. Additional quantities of cooler water complete the dissolving process. Soda ash is dissolved in a single step, using water at room temperature.

From the dissolving tanks the chemical solutions are delivered by water ejectors through pipelines to the points of use in the treating tanks.

The chemical-handling plant has been in service over a year and has given excellent service. Its operation has resulted in a substantial reduction in the cost of chemicals and in the labor required per million gallons of water treated. At the same time, uniformity of water treatment has been improved.

The chemical-handling plant was designed and constructed by Stone & Webster Engineering Corp with the active cooperation of Mr Thomas E Crossan, superintendent, and Mr William B Gurney, efficiency engineer, of the Louisiana Station.

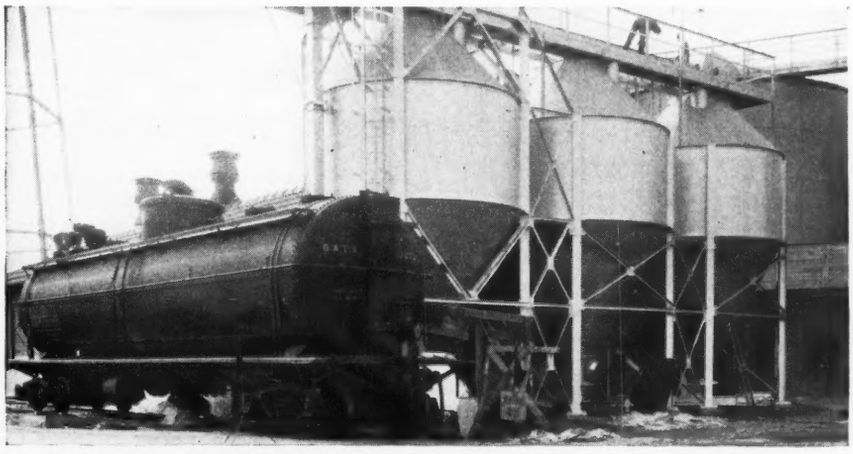


Fig. 2—Soda-ash, lime and Ferrisul storage bins, water-tight and dust-tight, each hold about one and a half railroad carloads of chemical

TABLE I—ANNUAL CHEMICAL CONSUMPTION
Condensing and Byproduct Power Plants

	Louisiana	*Williamsburg*
Salt as brine	3,000,000 lb	0
Quicklime	1,000,000 lb	0
Ferrisul	400,000 lb	0
Caustic soda	200,000 lb	5,400 lb
Sulphuric acid	150,000 lb	0
Sodium phosphate	60,000 lb	24,000 lb
Sodium sulphite	12,000 lb	2,500 lb

LIST OF PRINCIPAL EQUIPMENT

Dry-chemical storage bins.....Graver Tank & Mfg Co
3—2800 cu ft each

Dry-chemical conveyors and unloading equipment.....Stephens-Adamson Mfg Co
1—7-in. Redler conveyor elevator; 3—5-in. Redler conveyors; 1—Power shovel

Dry-chemical-feed equipment.....Builders Iron Foundry
3—Omega, automatic weighing and proportioning feeders, motor driven, including two dissolving tanks and one lime slaker
2—Proportioneers, water-proportioning pumps for water to lime slaker and Ferrisul dissolving tank

Weight recorders.....Builders Iron Foundry
Water flow recorder.....Builders Iron Foundry
Lime pump.....The Permutit Company
Water jet eductors for chemical solutions.....Schutte & Koerting Co

Central Stations Build for 1941

With the generous cooperation of utility engineers and construction forces,* POWER *has collected brief progress reports on the status of 25 new installations totaling nearly a million and a half kilowatts

TWIN BRANCH—The extension to this plant, Indiana & Michigan Electric Co (Mishawaka, Ind.), consisting of 76,500-kw, cross-compound, 2400-lb, 940-F reheat turbine and 550,000-lb-per-hr boiler, will start operation, as of present schedule, by the end of 1940. The entire turbine-room building is completed and steelwork for the boiler room will be erected by May 15. Some of the boiler steelwork is up but actual boiler erection will not start until July.

The 54,000-kw low-pressure element is scheduled for shipment May 1 and operation of this unit on steam from existing boilers is expected in August. The 22,500-kw high-pressure element is scheduled for shipment June, 1940, and operation in February, 1941. The condenser shell is on the job and practically completed. Field erection of station piping starts May 1.

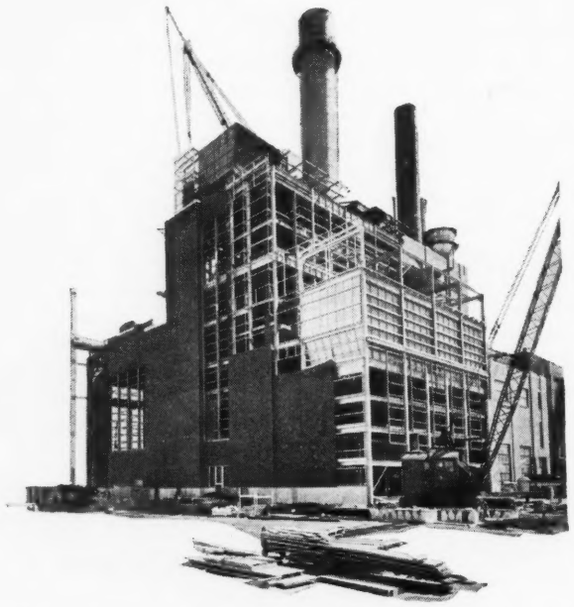
WATERSIDE—The Consolidated Edison Co (New York) addition includes 130,000 kw of new capacity. Two 65,000-kw, 60-cycle, 1250-lb, 925-F, 3600-rpm turbine-generators with tandem 200-lb feedheating turbines will be the largest topping units for high-pressure, 3600-rpm operation. Unit No. 6 (Westinghouse) will be served by two 615,000-lb-per-hr boilers (Combustion Engineering). Unit No. 7 (General Electric) will be served by two boilers (Babcock & Wilcox) of the same rating. This equipment, together with two 53,000-kw units installed in 1937–38, replaces 96 original boilers and completes the installation of topping units in this station.

As of May 1, the No. 6 boilers are about 50% erected with all pressure parts in place and welding of superheater and economizer joints in progress. Insulation and brickwork are started. The first turbine parts are expected early in May. The unit is scheduled for operation in November, 1940.

The No. 7 boiler supporting steel is now on order and the drums are expected July 1. Erection of the turbine-foundation steel has just been completed and first parts of the turbines are expected September 1. Initial operation is slated for July, 1941.

No. 6 main steam piping is about 50% erected and other lines are progressing satisfactorily.

A feature of the present installation is the extension of the Zeolite feed-water-treatment equipment to give total treated-water capacity of 1,200,000 lb per hr for makeup made necessary by delivery of an equivalent amount of steam to the New York Steam Corp.



100,000-kw cross-compound unit at Burlington for operation late in 1940

COMMERCE ST—The 35,000-kw extraction turbine for Wisconsin Electric Power Co (Milwaukee, Wis.) is scheduled for operation in October. Work on foundations is now in progress. The boiler is to be located on vacant property adjacent to the present plant and the turbine will take the place of several old engines in the present engine room.

A feature of this installation is the large percentage of steam that will be extracted from the turbine during high heating loads. At 375,000 lb-per-hr throttle flow, 240,000 lb per hr of commercial heating steam will be extracted and 24,000-kw load carried. With no extraction to the heating system, 35,000 kw can be carried at 310,000-lb-per-hr throttle flow. Makeup to the 1300-lb, 900-F boiler will frequently reach 75%.

MILLERS FORD—Two new 1250-lb, 900-F, 375,000-lb-per-hr boilers and a 30,000-kw, hydrogen-cooled, superposed turbine-generator are now being installed by Dayton Power & Light Co (Ohio). Three low-pressure boilers were removed to make room for the new steam-generating units.

Erection of both boilers has been started; the first will be completed by July 15, 1940, and the second by August 15. The turbine unit will be installed alongside the 1936 unit of similar capacity in space provided when the earlier unit was put in. The new turbine can be supplied from either the present high-pressure boiler plant or from the boilers now being installed.

Turbine erection started April 1 and will be finished June 1, this year. It

will be supplied with steam from existing boilers until the new units are completed.

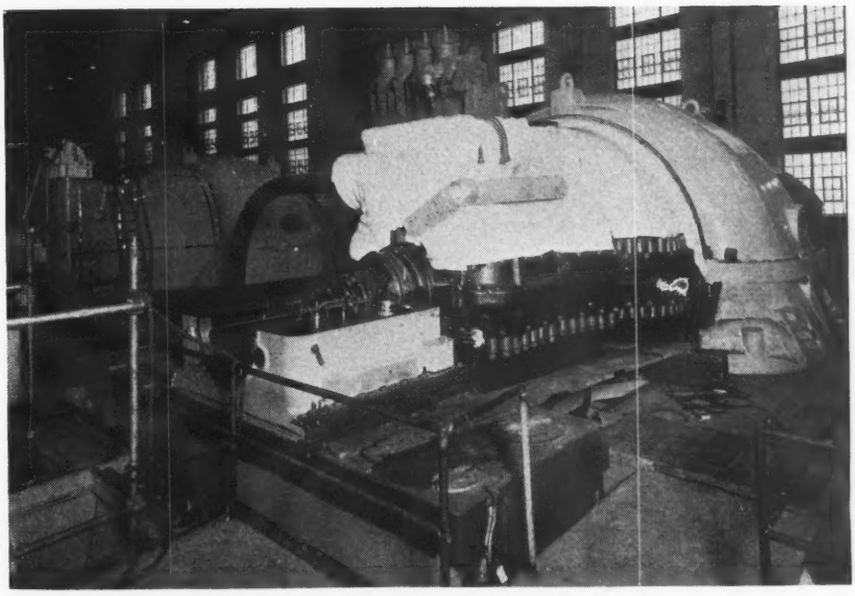
Installation of feed pumps, precipitators and other auxiliary equipment started April 1 and will be finished by July 1. These scheduled completion dates are for preliminary operation and adjustment.

The entire addition to Millers Ford is to be complete and ready for regular operation by October 1, 1940. With this new unit, total plant capacity will be 170,000 kw, of which 60,000 kw is in topping turbines.

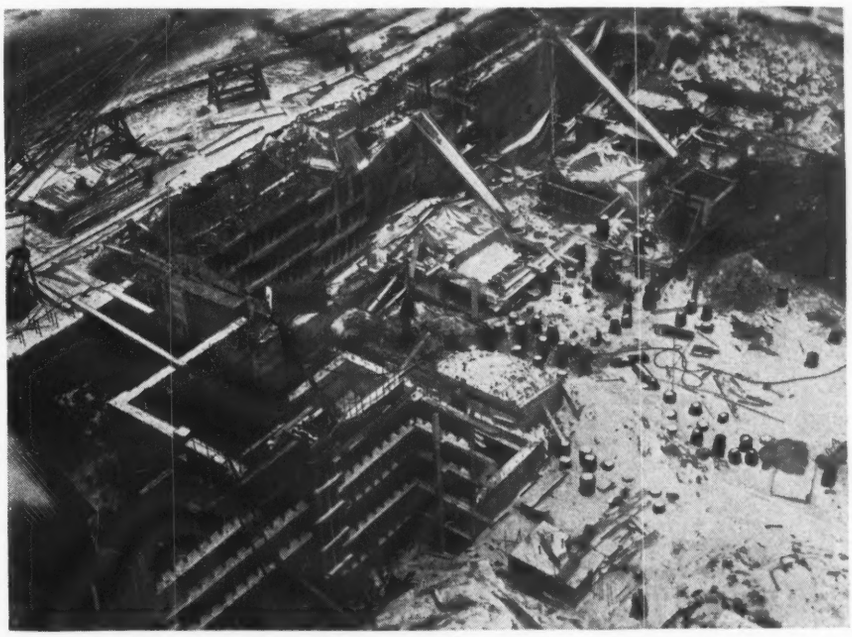
CHESTER—A 50,000-kw topping turbine-generator and two 600,000-lb-per-hr, 1350-lb, 935-F boilers are now being installed by the Philadelphia Electric Co (Pa.). Four old boilers and their supporting steel have already been removed and steel for the new boilers is about 40% erected. The first drum was shipped April 1 and the boiler-erection schedule calls for boilers to be fired about January 1, 1941.

Turbine-foundation excavations are complete and concrete pouring started April 1. The foundation is to be ready for the machine about September 1. Turbine erection, starting then, will be finished for preliminary operation about February 1, 1941. All major equipment has been purchased. The unit is scheduled for commercial operation April 1, 1941.

BUZZARD POINT—Construction of the Potomac Electric Co extension (Washington, D. C.) reached the point of practical completion of the building's main structural-steel frame on April 1. Erection of the 525,000-lb-per-hr boiler has started and the foundation is ready for the 50,000-kw turbine-generator. Erection of the turbine is scheduled to

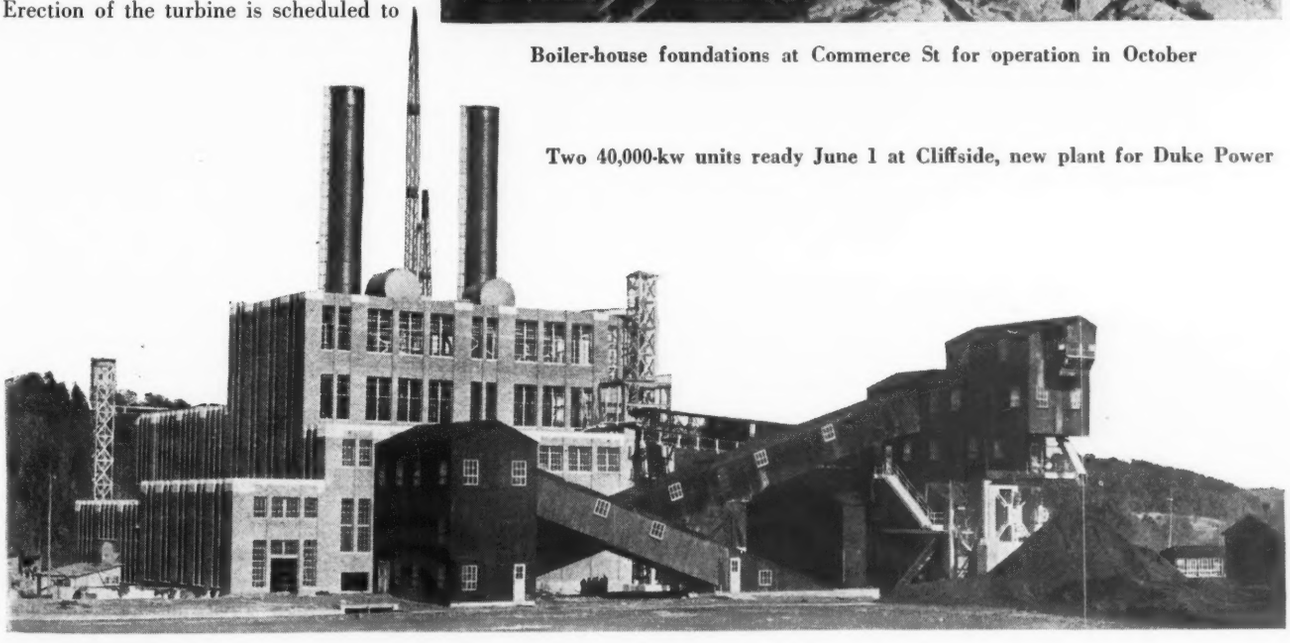


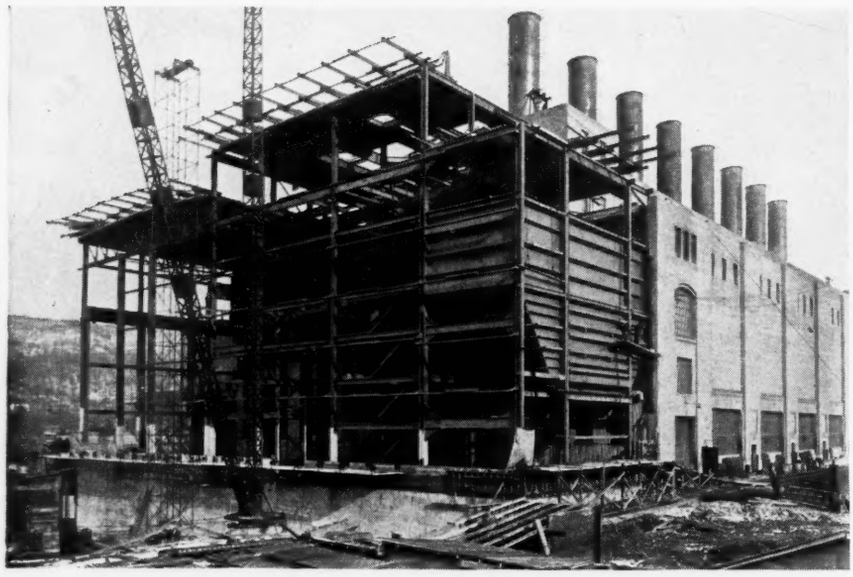
Delray 75,000-kw, 865-lb, 910-F unit scheduled for service in August. Another follows



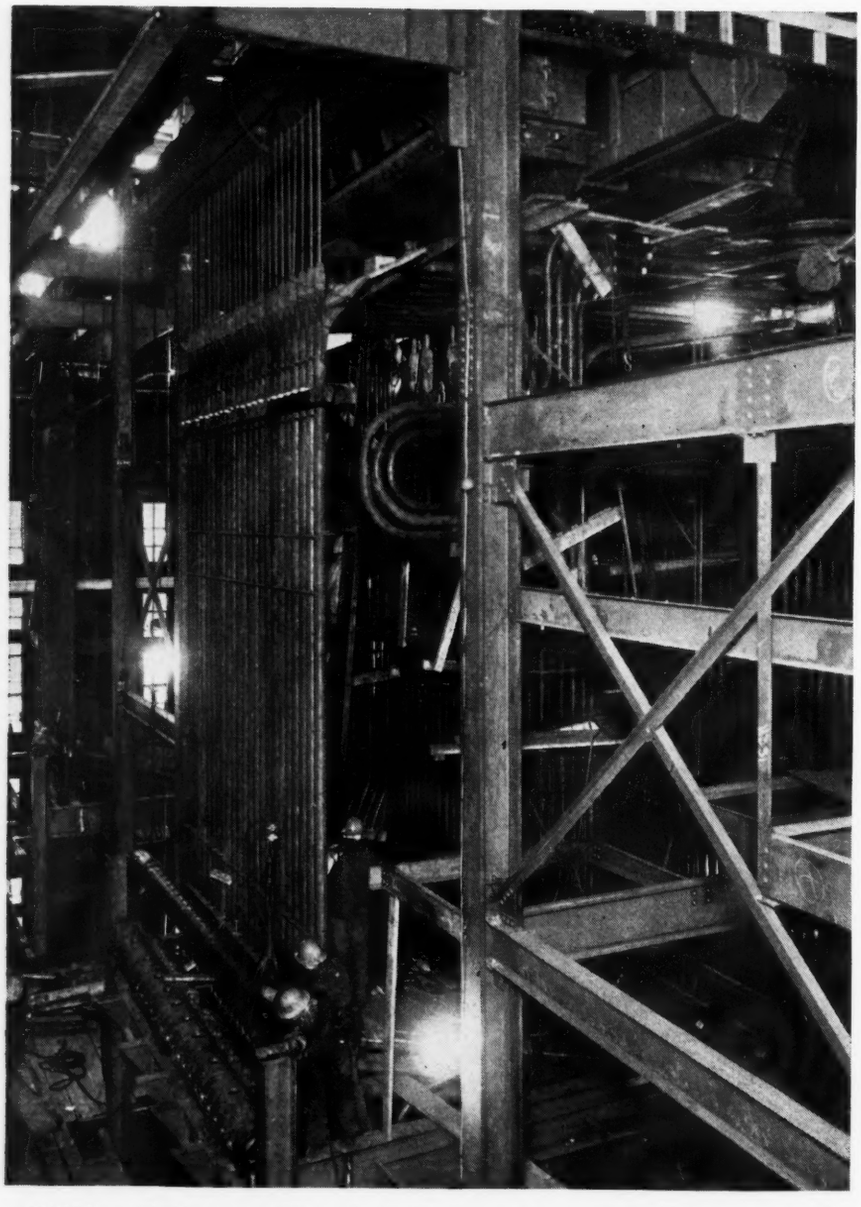
Boiler-house foundations at Commerce St for operation in October

Two 40,000-kw units ready June 1 at Cliffside, new plant for Duke Power





35,000-kw extension at Toronto Station is scheduled for completion late this year



30,000-kw, 1250-lb top at Millers Ford will use existing steam pending new boilers

begin May 1. Masonry work has been started and construction is well advanced on the condensing-water intake and discharge tunnels, also on the concrete pits and foundations for coal-storage and transfer facilities. First operation is expected about October 1.

OIL CITY—Building contract proposals have just been received for an extension to Keystone Public Service Co (Oil City, Pa.) to house a 100,000-lb-per-hr boiler (Foster Wheeler) and auxiliaries. Work started early in April and the boiler is to be ready for service by October, 1940.

WEST READING—Plans are being drawn up so that work can be started about May 1 on the plant extension by Metropolitan Edison Co, (Reading, Pa.). This addition will house a 20,000-kw superposed turbine-generator and two 275,000-lb-per-hr boilers and auxiliaries. The unit is scheduled to be ready for service by February 1, 1941.

VIENNA—Preliminary work is under way by Delmarva Power Co (Vienna, Md.) for a plant extension to house a 7500-kw turbine-generator and an 80,000-lb-per-hr steam generator and auxiliaries. The installation should be complete and equipment ready for service by February 1, 1941.

ALEXANDRIA—Contract has been awarded and work is now in progress on a plant extension for Virginia Public Service Co (Alexandria, Va.). The addition will house a 15,000-kw turbine-generator and two 80,000-lb-per-hr boilers and auxiliaries. The installation is scheduled for operation in December, 1940.

PARR—Work has been started on the installation of a 150,000-lb-per-hr steam generator by the South Carolina Electric & Gas Co (S. C.). The boiler will be ready for service September 1, 1940.

JOHN C WEADOCK — The first 35,000-kw unit for Consumers Power Co (Bay City, Mich.) is rapidly nearing completion. The boilers for both first and second units have been given hydrostatic tests. The first turbine is due for operation some time this May. Delivery of the second 35,000-kw machine is expected in December, 1940, and the unit is scheduled for completion early in 1941.

EAST PEORIA—The plant addition of Central Illinois Light Co, which includes new boilers and a 35,000-kw generating unit, is in the early stages of construction. The substructure is now practically complete and the unit is to be ready for service late in 1940.

TORONTO—An additional 35,000-kw unit is being installed for Ohio Edison Co. The turbine foundation is nearing completion and the building is about to be enclosed. The entire installation is scheduled for completion late in 1940.

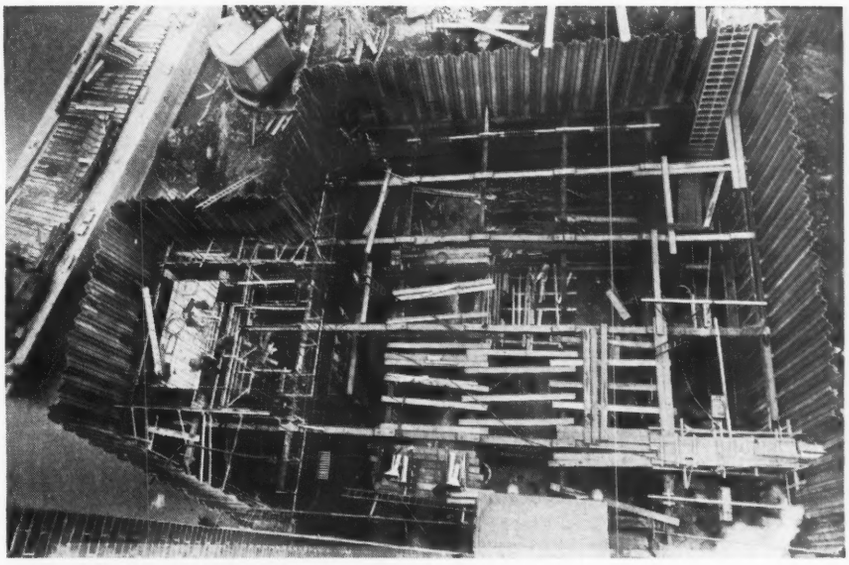
MACON—A 40,000-kw generating unit is being installed for Georgia Power Co at a new location near Macon, Ga. The plant is now in its early stages. Excavation is practically finished and erection of the substructure is about to begin. The unit is due for operation about the middle of 1941.

CHICKASAW—The Alabama Power Co is installing a 40,000-kw unit in an existing plant at Chickasaw, Ala. Construction is just getting fairly started; a portion of the old boiler house has been demolished. Piling for the new boiler foundation is about to be driven. The unit is scheduled for service in the late Spring of 1941.

CEDAR RAPIDS—Excavation for the basement has been completed and walls poured for a 15,000-kw extension of the 6th St Station of Iowa Electric Light & Power Co (Cedar Rapids, Iowa). The turbine (General Electric) will operate at 750 lb, 750 F. The 300,000-lb-per-hr, pulverized-fuel-fired Springfield boiler will be served by Babcock & Wilcox Type E mills, Superheater Co superheater and Foster Wheeler economizer.

CLIFFSIDE—Boiler erection is 98% finished, turbine erection started and condenser installation 75% complete at a new plant of Duke Power Co (N. C.). Two 40,000-kw units are scheduled for first operation June 1, 1940.

BUCK—Excavation is 50% complete for the new single-unit, 80,000-kw plant of Duke Power Co (N. C.). The construction camp is complete, including such equipment as derricks, concrete mixers, conveyors, etc.



Foundations and substructure for 35,000-kw unit at East Peoria practically finished

DELRAY—The 75,000-kw turbine unit No. 15, together with condenser, circulating pumps, feed pumps and other auxiliaries, for the Detroit Edison Co (Mich.), are now under construction. The turbine is scheduled for "turning over" July 15 and the first of two boilers is to be ready for service August 9. The second turbine will follow at the end of 1940. The 344,000-lb-per-hr boilers will generate steam at 865 lb, 910 F, at the superheater outlet.

The setting for the first new boiler is about 80% complete, and the drying-out fire is slated for early June. Turbine erection is about 90% complete and condenser erection is practically finished. Main steam and boiler-feed piping are about 75% complete. After May 1, the rest of the auxiliary pumps, motors and controls remain to be erected, piping completed, equipment tested and the turbine unit made ready for turnover July 15.

OSWEGO—The first 80,000-kw, hydrogen-cooled condensing unit of Central New York Power Corp is nearing completion. Operation is scheduled for August, 1940. General Electric, 1250-lb, 900-F turbine will be supplied by single 850,000-lb-per-hr Babcock & Wilcox boiler. A second similar unit is scheduled for operation in 1941.

POWERTON—A new 105,000-kw condensing unit for Commonwealth Edison Co (Pekin, Ill.) will go into service in October of this year.

NORTHWEST—A 50,000-kw superposed turbine for Commonwealth Edison Co (Chicago, Ill.) is scheduled for completion in the fall of 1941.

BURLINGTON—A 100,000-kw, 3600-rpm, cross-compound turbine-generator is now being installed by Public Service Electric & Gas Co (Newark, N. J.). The turbine consists of two 50,000-kw elements and will be supplied at 1250 lb, 950 F by two 550,000-lb-per-hr boilers. Erection of the boiler is about 20% complete, the condenser about 75%, and delivery of the turbine-generator is scheduled to start some time in May. Operation is expected in the latter part of 1940.

MARION—Foundation work for a superposed installation by Public Service Electric & Gas Co (N. J.) has just started. The unit will be a 50,000-kw, 3600-rpm turbine-generator to operate in conjunction with three existing 200-lb condensing machines totaling 57,600 kw. Steam will be supplied by two 550,000-lb-per-hr boilers. Operating conditions at the turbine throttle will be 1250 lb, 950 F. Operation is scheduled for the summer of 1941.

First 35,000-kw turbine at John C Weadock to operate in May. Another next year

The Lowdown on 6 x 19 Wire Rope

A S Rairden, Wire Rope Division, Wickwire Spencer Steel Co, explains the different types of lays for 6x19 rope and shows the applications for which each is intended

▶ WIRE ROPE IS USED for various purposes in practically every industry, yet considerable misunderstanding exists regarding its construction and application. This rope is made in a great many constructions, but the most popular one is known as 6x19. We will therefore confine our attention to this design.

A 6x19 rope is made of 6 strands of 19 wires each, usually laid around a hemp core. In some constructions a wire-rope core is used to give a more substantial foundation against compression from the surrounding strands. Each strand comprises a center wire, with 6 wires twisted around it and 12 wires laid over the 6, as in Fig. 1. Cross section of such rope is shown in Fig. 7*A*.

Various Types

This type of rope is made in 4 different geometrical designs: 2-operation, Warrington, filler-wire and Seale. With the ramifications of varying grades, direction and kind of lay, types of cores, preformed and non-preformed constructions, there are about 288 ways in which 6x19 rope can be made. Because of this it is important that rope users properly identify the type of rope they want when ordering from the manufacturer. If they cannot do this then the service and equipment should be carefully described so that the manufacturer can recommend a design that will give the most economical and satisfactory service.

The wires are laid in the strands and the strands in the rope to form four different constructions: regular lay, right lay, Fig. 2; regular lay, left lay, Fig. 3; Lang lay, right lay, Fig. 4; Lang lay, left lay, Fig. 5. Wires in the strands of a regular-lay rope are twisted in an opposite direction to the rope lay. In the right lay, the strands take the form of a long-pitch, right-hand thread on a bolt, Fig. 2. Left lay is just the reverse of right lay and takes the form of a long-pitch, left-hand thread, Fig. 3.

Lang-lay rope, Figs. 4 and 5, has wires in the strands twisted in the same direction as the rope lay. This construction may be either right lay, Fig. 4, or left lay, Fig. 5. In the regular-lay rope, wires on the outside surface of the rope run almost parallel with the axis of the rope, but in Lang lay they are at an angle.

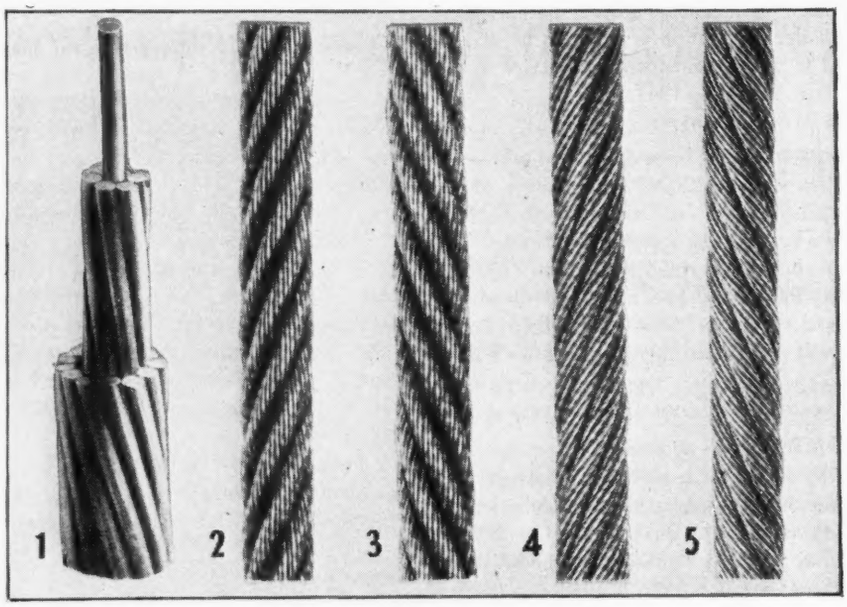


Fig. 1—Steps in building a 19-wire strand. Fig. 2—Right-lay, regular-lay rope. Fig. 3—Left lay, regular lay rope. Fig. 4—Right-lay, Lang-lay rope. Fig. 5—Left-lay, Lang-lay

A 2-operation 6x19 rope, Fig. 7*B*, is one in which the 6 intermediate wires are twisted with a different lay, usually a longer one, than the outside layer of 12 wires of each strand. The direction of twist is the same in both layers. For a right-hand, regular-lay wire rope, Fig. 2, the pitch or lay direction within the individual strands is left-hand.

The 2-operation, 6x19 type was the first rope of this constructon made, but is now used very little in the United States. Some manufacturers still make 6x19 galvanized standing or guy ropes in this construction. However, foreign manufacturers make 6x19 2-operation rope generally in both bright and galvanized. This is usually done to reduce cost of manufacture, for the construction lends itself to the use of a longer lay when assembling the wires into the individual strands.

The longer lay within the strands adds slightly to the strength of the final rope assembly. However, the 2-operation principle does not permit building maximum bending-fatigue-resistance into the rope. When the wires are assembled into the strands with different length of lay, the wires in the intermediate and outer layers cut across each other and establish point- instead of line-bearing contacts between them. These point contacts, when the rope is loaded, develop severe compressive forces that tend to cut or nick the wires

Fig. 6—Hoist driven by 50-hp motor through gear speed reducer operates drag-line scraper handling as high as 3 tons of material per minute

at these points. These nicks accelerate fatigue breaks of the wires as they bend and straighten when the rope travels over the sheaves.

The 2-operation 6x19 rope is well suited to severe drum-crushing conditions caused by haphazard criss-crossing of the rope when wound on and off a hoisting drum with a smooth face. Thus, this type rope is used occasionally on coal-mine slusher hoists, particularly in the presence of corrosive mine water. All the wires in a 2-operation 6x19 rope are practically the same size, as in Fig. 7*B*, and are, therefore, best suited to resist corrosion. Where fatigue is not the controlling factor in rope life, but if the rope fails quickly from drum-winding abuse or from corrosion, the 6x19 2-operation rope may be applied economically.

The Warrington 6x19 construction gets its name from the man who invented it. In this type, 6 intermediate wires are twisted around a center wire. Over the intermediate layer 12 more wires are assembled, alternately small and large in size, Fig. 7*C*. Frequently this type is called a 6x19 3-size-wire construction, for it is often made with the inner seven wires all of one size and the outer layer of two different sizes of wires.

The wires are all twisted around the center wire with one length of lay and the individual strand construction and assembly of the strands into a rope are all done in one twisting operation. We might identify this construction and those subsequently described as 1-operation types to distinguish them from the 2-operation. Within the 1-operation assemblies the wires in the strands lay in a parallel interlocking state to form line contacts between wires rather than point contacts as in the 2-operation rope.

When load is applied to the finished rope the resultant compressive forces between wire layers are distributed along the line contacts and the pressure at any one point of contact is much lower than in a 2-operation rope. The individual wires are, therefore, more free to revolve about their individual axes as the rope runs over its sheaves, which reduces bending fatigue of the individual wires to a minimum for any given set of conditions.

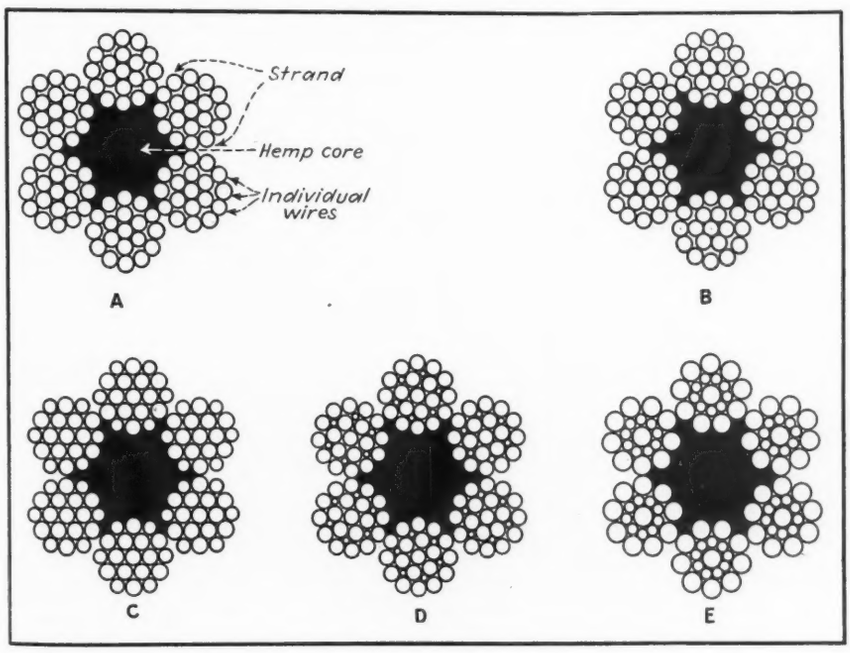
Warrington 6x19 rope is extensively used in oil fields on cable tool-drilling rigs, on passenger and freight elevators, and to a lesser degree on all types of vertical hoisting. The dissimilar size outer wires tend to make this rope an unpredictable type from a service angle. The smaller outer wires have excellent bending-fatigue resistance qualities, where the larger outer wires have less favorable bending-fatigue resistance but excellent resistance to abrasion. These important qualities in the outer wires of any rope are in this case working at cross purposes. Because of this the 6x19 filler-wire type was developed to obtain uniform bending-fatigue and abrasion-resistance qualities.

Filler-Wire Construction

The 6x19 filler-wire rope, Fig. 7*D*, is also frequently referred to as 6x19 1-size-wire construction with fillers. Actually there are 25 wires within each strand; the 6 small wires are frequently termed fillers and left out of the count when identifying this construction. At one time the filler wires were usually made of a soft low-carbon steel. Today, however, the fillers are nearly always made of the same kind of metal as the other wires. When the filler wires were made of soft low-carbon steel they were usually omitted when computing the theoretical strength of the rope. Today, however, they are included because they take their share of the applied rope load. This type of 6x19 rope is most widely used on vertical hoists where the minimum-size sheave is not less than 24 times the diameter of the rope.

A 6x19 Seale-type rope, Fig. 7*E*, is also named for its inventor. The construction differs from the other 6x19 types in that the intermediate and outer

(Continued on page 132)



Figs. 7*A* to *E*—Cross sections of different 6x19 wire-rope constructions

High-Efficiency, High-Capacity Water-Pumping Plant for Milwaukee

Arthur Rynders, Dept of Public Works, Milwaukee, and mechanical engineer for the project, reports on this recently completed 315-mgd pumping plant. Synchronous-motor-driven units handle city water at an over-all efficiency of over 88%

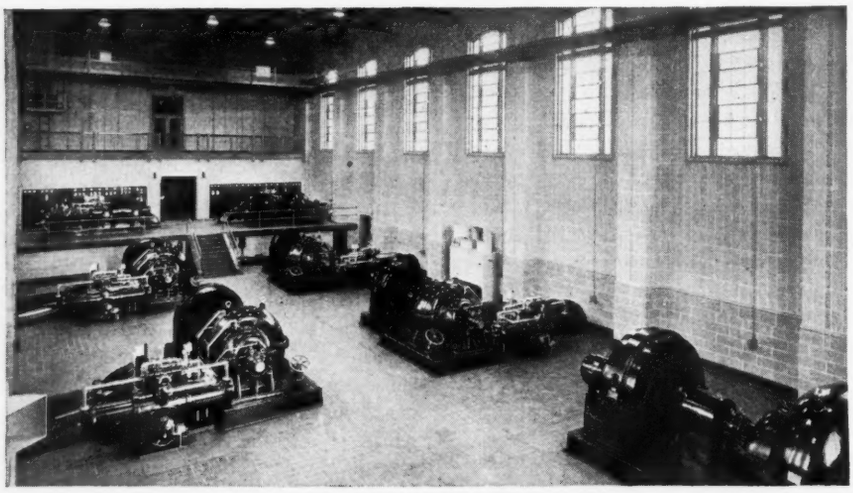


Fig. 1—In this room are one 75-mgd, four 50-mgd and two 20-mgd motor-driven pumps

▶ MILWAUKEE, WIS., THIS YEAR placed in operation its $5,000,000 water-purification and low-level pumping plant. The plant is built on 14 acres of man-made land on the shore of Lake Michigan. Water is taken from a 15-ft diameter shore shaft through a new 12-ft diameter tunnel and delivered to the suction side of the low-level pumps. Precautions against surges were included in the structure of the new tunnel. Near the pump building the tunnel divides into three branches, each branch leading to two low-level pump-suction pieces.

The low-level pumps discharge water from Lake Michigan into coagulation basins. Water then flows by gravity through the purification plant to filtered-water reservoir and then through a new effluent tunnel to the old-tunnel system, into which has been built suitable gates and other appurtenances. The low-level pumping equipment consists of four 50-mgd and one 75-mgd units with room for a sixth, Fig. 1.

Two 20-mgd wash-water pumps discharge filtered water from the effluent shaft to the wash-water tank, to wash the filter beds. These units are on the balcony near the switchboard, Fig. 1. Pertinent details of the installation are given in Table II.

Each pump is driven by a synchronous motor with an engine-type exciter on the outboard end of its shaft, all mounted on a common cast-iron bedplate. The foundation supporting each pumping unit also carries the pump suction and discharge valves and is isolated from the building by cork. Foundation design was greatly simplified by the use of butterfly suction valves, since they have small face-to-face dimensions and clearances perpendicular to the pipe center line. An expansion joint, below each pump suction valve, connects to the pump suction piece. Semi-rigid couplings form the connection between the hydraulically operated discharge valves and the discharge piping system.

Hydraulic-Pressure System

A separate hydraulic-pressure system provides operating power for the pump discharge valves. This system consists of a tank under the wash-water-pump balcony and piping to the valve hydraulic cylinders. Two-thirds of the volume of the tank is normally water and one-third air under approximately 100-lb pressure. Tank and piping are sized to provide hydraulic power for closing eight discharge valves before

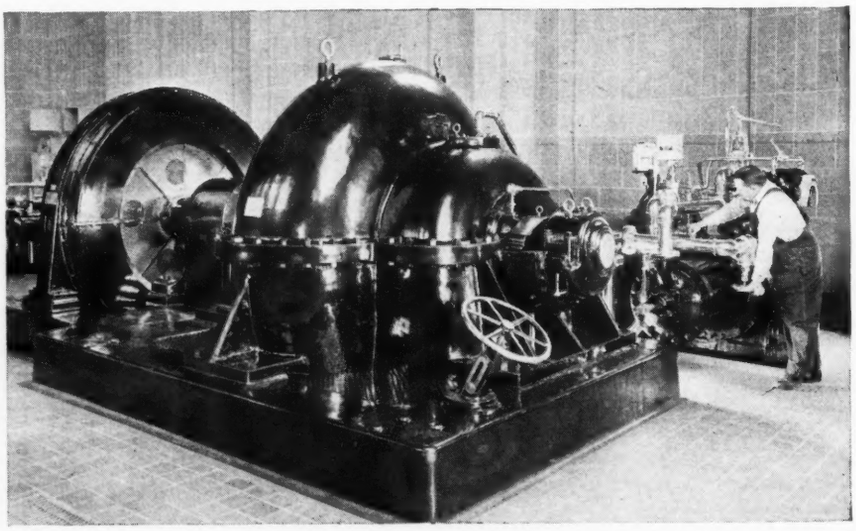


Fig. 2—This 75-mgd pump is driven by a 500-hp, 2300-volt synchronous motor

reversal of rotation of the pumping units. It has been shown by test that the station can shut down in case of a power failure without a serious incident regardless of the number of pumping units operating at the time.

All hydraulic-pressure, priming, heating and electrical piping are run exposed in a trench under the pump-room floor. The trench is 4 ft wide by 6 ft high, and runs the length of the pump building along the center line terminating under the wash-water pump balcony. Branch trenches are carried under each low-level motor, under each low-level pump and discharge valve.

Pumping units and major piping are painted a gloss black and the switchboard is finished in a dull black. All small piping and trim are chromium plated. The floor is red quarry tile with black terrazzo borders. Walls are terra cotta in two shades of tan.

Power Supply

Electric power is supplied by the Wisconsin Electric Power Co, delivered to the plant by two underground lines, one at 26,400 volts from Port Washington and the other at 13,200 volts from the Lakeside power plant. Each line runs in a separate duct system, well segregated physically from the others, and terminates in the city-owned substation at the rear of the pump building. A suitable high-tension breaker, metering transformers and power transformer are incorporated into the substation for each supply.

The 2300-volt leads from the power transformers run underground to line breakers inside the switch rooms, each 2300-volt lead feeding a separate bus. Four of the large synchronous motors connect to one bus and three to the other with a bus tie between. Normally, the tie is closed and power is obtained through one line only. All auxiliaries can be connected to either bus.

Oil circuit breakers and bus structure are along the south wall of the pump building. The switchboard is in the partition wall separating the switch and pump rooms. Control for full-voltage automatic motor starting and control necessary for the automatic and protective features are mounted on the rear of the switchboard.

Considerable testing was carried on in the shops of the manufacturers. Pittsburgh Testing Laboratories were engaged by the City to witness these tests, usually as a part of the shop inspection. These tests furnished the City with certain information regarding the performance of individual pieces of equipment. After the installation was completed Milwaukee conducted its own acceptance tests to demonstrate ability of the equipment to meet all service requirements.

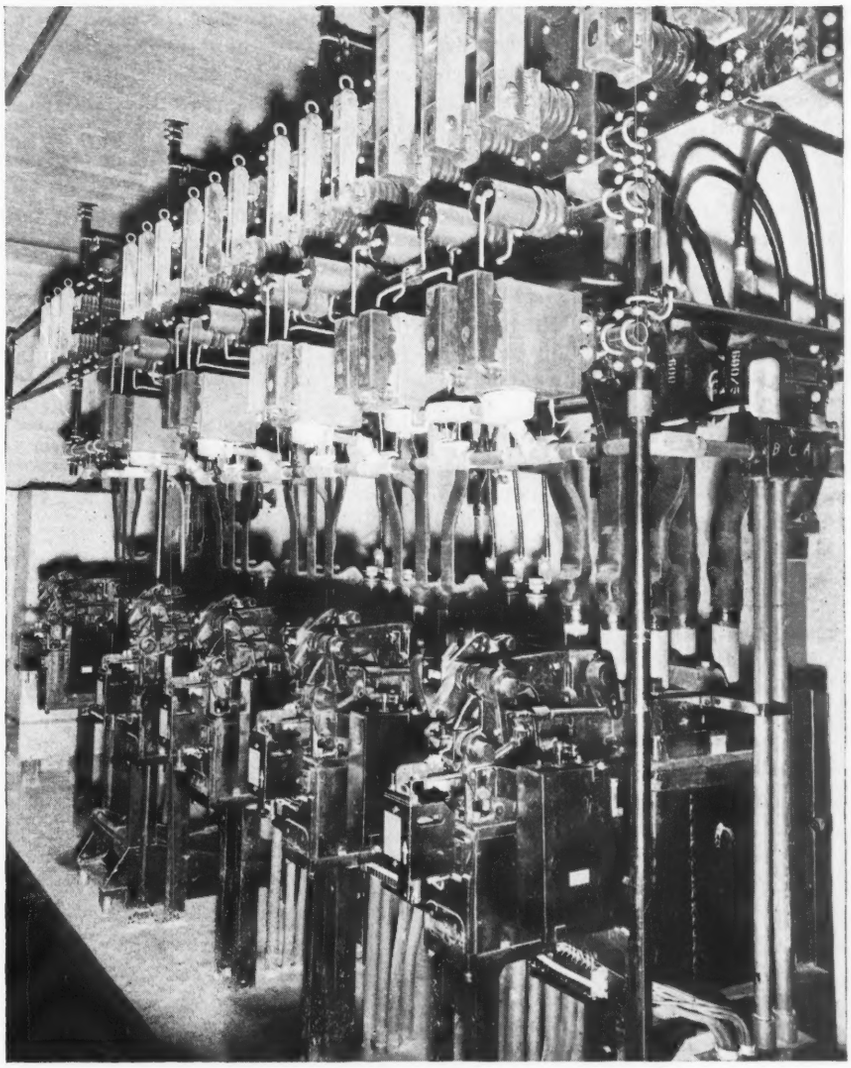


Fig. 3—One section of the indoor switching equipment for the pump motors

Pumping equipment was subjected to further tests to determine fulfillment of guarantee. The guaranteed combined efficiency, wire to discharge, was specified to be not less than 83% for all units, which was met by a comfortable margin as shown in Table I. Efficiency tests were conducted in accordance with standards of the Hydraulic Institute. Water volume was measured volumetrically, which, in the light of the City's experience in the last few years, is a very accurate and satisfactory method. To measure the volume this way it was found advantageous to prepare elevation-content curves for the tank or basins into which the unit under test was discharging. Correction factors for leakage, expansion and temperature were also determined. Levels were obtained with a hook gage and all readings were taken from a bench mark.

Water levels in the coagulation basin and wash-water tank are maintained within prescribed limits. When levels approach the lower limit, a pumping unit is selected for operation. With the pump primed, the suction valve open and the discharge valve closed, the unit is started by pushing the corresponding start button on the switchboard. All subsequent steps in starting are automatic in that the unit comes up to approximately 96% speed, field is applied, shut-off pressure develops in the pump casing and the discharge valve opens at a predetermined rate. Ordinary motor protection is expanded to protect the pumping operation, in that should power to the motor fail, the discharge valve closes at a rate timed to avoid reversal of the pumping unit and minimize water hammer. An emergency stop pushbutton is included in the protection scheme.

Normally, the pumping unit is stopped by pushing the corresponding pushbutton, subsequent operations being automatic in that the discharge valve starts to close at a slow rate. When the valve is almost closed, its move-

ment trips a limit switch which trips the motor breaker and closes the valve at a fast rate. Suction and discharge-pressure disturbances due to starting and normal stopping are confined to very small limits.

Discharge valves can be operated manually through hydraulic control in case automatic devices fail. Suction valves are operated manually through a handwheel (see foreground Fig. 2) and suitable gearing. Experiments showed that, with flow fully reversed through a pump, the 54-in. diameter butterfly suction valves can be closed manually in 12 to 15 sec. Operating power for valves was varied for reliability. Suction valves are manually operated, discharge valves hydraulically, and discharge-piping valves electrically.

Future possibilities were considered at the time this plant was designed. It seemed reasonable to expect a continued healthy growth in the population served by the Milwaukee Water Works. To meet these expectations there appeared to be two possibilities: (1) enlarge the present plant, (2) build a separate plant. With both in mind, provisions were made in the present plant for doubling its capacity if and when found desirable.

Doubling plant capacity will require making an additional strip of land, 300 x 1387.5 ft, to the east of the present site, constructing mixing, coagulation, and filtering facilities which tentatively would duplicate those in the present plant, installing and replacing some pumping equipment, increasing capacity of the power transformers, increasing one power cable, and adding to the tunnel system in addition to minor changes. All of these changes can be accomplished without interrupting operation of the present plant. Capacity of the present plant is 200 mgd, whereas the ultimate capacity of the plant as planned is 400 mgd.

The present plant was a PWA project. Alvord, Burdick & Howson were the consulting engineers. The plant was designed and built under the direction of the City Engineer's Office. R E Stoelting, Commissioner of Public Works, J P Schwada, city engineer, and H H Brown, engineer in charge, had direct supervision over the project, with the writer serving in the capacity of mechanical engineer.

TABLE I—PUMPING EQUIPMENT ACCEPTANCE-TEST RESULTS

	Volume of water pumped, mgd	*Total dynamic head, feet*	*Water horse-power*	*Horsepower input to driver*	*Combined efficiency*
Wash-water pump No. 1....	17.4	91.636	280.0	326.0	85.8
Wash-water pump No. 2....	19.1	87.158	293.0	336.0	87.2
Low-level pump No. 3.....	53.3	30.998	292.0	330.0	88.5
Low-level pump No. 4.....	51.2	30.684	277.0	314.0	88.2
Low-level pump No. 5.....	51.6	30.798	280.0	316.9	88.3
Low-level pump No. 6.....	51.2	30.580	275.5	314.2	87.7
Low-level pump No. 7.....	85.1	31.067	465.2	536.2	86.7

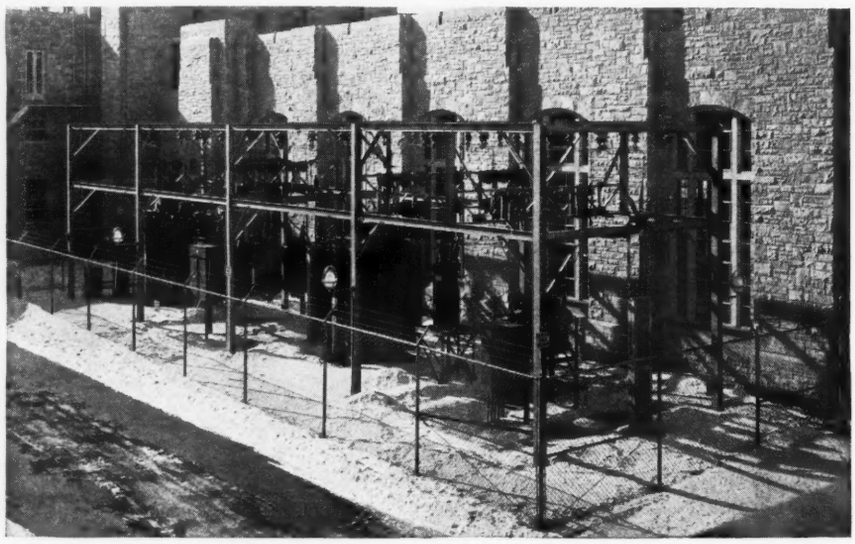


Fig. 4—Outdoor substation supplies 2300-v power from two 2000-kva transformers

TABLE II—PRINCIPAL POWER AND PUMPING EQUIPMENT

MILWAUKEE WATER-PURIFICATION PLANT

Pumps:
Centrifugal pumps, bottom suction and side discharge.....Allis-Chalmers Mfg Co
Two 20-mgd, 80-ft-head; four 50-mgd, 30-ft-head; one 75-mgd, 30-ft-head
Motors, synchronous, 2300-v, unity-pf, 3-phase, 60-cycle....Allis-Chalmers Mfg Co
Two 350-hp, 720-rpm; four 350-hp, 300-rpm; one 500-hp, 240-rpm
Couplings, steel and rubber, six 36-in. and one 48-in.....S R Dresser Mfg Co
Suction sluice gates, two, manually operated.....Rodney Hunt Mfg Co
5x10 ft, 60-ft design head
Suction pieces, flanged, cast iron.....Goslin Birmingham Mfg Co
Suction valves, butterfly, manually operated.....Allis-Chalmers Mfg Co
Two 24-in., 170-ft test head; five 54-in., 70-ft test head
Expansion joints, flanged steel.....Allis-Chalmers Mfg Co
Two 24-in., 70-ft design head; five 54-in., 70-ft design head
Pump-discharge valves, automatic, conical-plug.....S Morgan Smith Co
Two 20-in., 170-ft test head; four 36-in., 70-ft test head; one 48-in., 70-ft test head

Piping and valves:
Discharge piping, electric fusion welded, 24—84 in. diameter.....Koppers Co
Discharge-piping valves, four, butterfly, electrically operated, 60-in., 70-ft test head { Allis-Chalmers Mfg Co / Cutler-Hammer, Inc
Discharge-piping valves, gate, electrically operated. One 36-in., two 24-in., 170-ft test head { Kennedy Valve Mfg Co / Cutler-Hammer, Inc
Coagulation-basin sluice gate, elec. operated { Columbia Iron Works / Cutler-Hammer, Inc

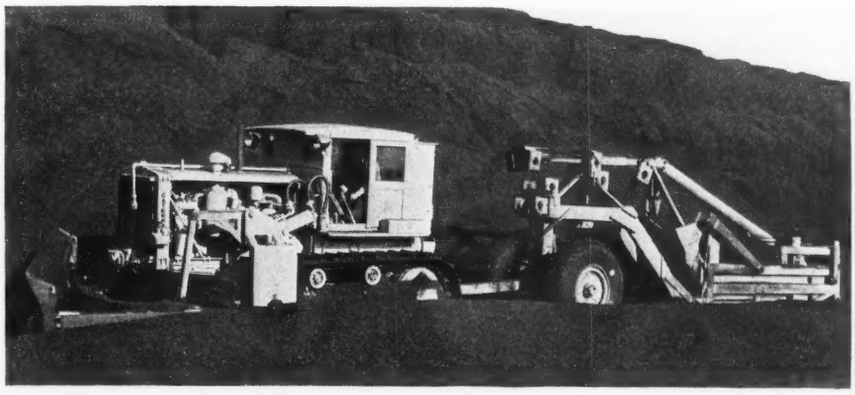
Miscellaneous:
Priming pumps, motor-driven rotary, two 100-cfm, 16-in. Hg.....Nash Engrg Co
Sump pumps, motor driven, two 200-gpm, 50-ft head.....Chicago Pump Co
Vacuum pumps, two, duplex, motor-driven.....Sterling Engineering Co
Crane, 25-ton, bridge.....Harnischfeger Corp
Unit heaters, floor-type, two 650,000-Btu-per-hr.....Bayley Blower Co
Lighting fixtures, high-bay, ceiling, eleven 1000-watt.....Hollophane Co

Pump-room electrical equipment:
Switchboard, 16 steel panel.....Allis-Chalmers Mfg Co
Field rheostats.....Cutler-Hammer, Inc
Differential, overcurrent & undervoltage relays....Westinghouse Elect & Mfg Co
Field-application relays and auxiliary relay panel.....Cutler-Hammer, Inc
Ac and dc ammeters and recording demand whr meter
Westinghouse Elect & Mfg Co
Recording voltmeter and wattmeter.....Esterline-Angus Co
Dc voltmeter.....Weston Electrical Instrument Co
Test switches.....Westinghouse Elect & Mfg Co
Disconnect switches.....Schweitzer-Conrad Co
Main & tie circuit breakers, three 1200-amp, 15,000-v.....Allis-Chalmers Mfg Co
Motor-branch circuit breakers, nine, 600-amp, 15,000-v.....Allis-Chalmers Mfg Co
Potential and current transformers.....Allis-Chalmers Mfg Co
Motor-generator set, 1.5-kw.....Allis-Chalmers Mfg Co
Storage battery, 60 cells, 120 amp-hr.....Electric Storage Battery Co
Magnetic contactor connecting generator to battery.....Cutler-Hammer, Inc

Outdoor substation:
Cable and potheads for 26.4 and 13.2 kv.....General Cable Co
Struct-steel bus supports and 34.5 & 15-kv discon switches.....Delta-Star Co
Circuit breakers, 26.4 and 13.2 kv.....Allis-Chalmers Mfg Co
Power transformers.....Allis-Chalmers Mfg Co
Two, 3-phase, 2000-kva, 26,400 and 13,200 to 2300 volts
Lighting transformers, 50-kva, 2300 to 230 and 115 v.....Allis-Chalmers Mfg Co
Aux transformers, 25-kva, 2300 to 460 and 230 volts.....Allis-Chalmers Mfg Co
Substation lighting, five 300-watt units.....Hollophane Co
Substation fencing.....Cyclone Fence Co

Handling Coal With Safety

To prevent fires in a large-capacity system, coal is piled in horizontal layers by a caterpillar tractor hauling a carryall and shoving a bulldozer



Caterpillar tractor pushing a bulldozer and hauling a carryall handles 130 tons per hr

▶ A THOUSAND TONS OF COAL a day—that's the requirement of The Dow Chemical Co, Midland, Mich. And when an industry's coal requirements reach figures as large as that, several major problems of handling and storage present themselves.

Until 1937, the coal was stored in conical piles of 8000 to 12,000 tons each. Temperatures were taken weekly and an average rise of one-half degree per day was noted, caused by the chemical reaction between the oxygen in the air and the constituents of coal. It was often found necessary to repile the coal in order to eliminate this fire hazard. This involved expense, but the cost was minor compared to that sustained when fires started, as anyone who has had the experience of subduing a blaze in a large coal pile can testify.

A Storage Problem

Until three years ago, however, the conical method of piling still seemed the most economical, but when at that time it became necessary to carry a larger stock for a longer period of time, various other possibilities in storage procedure were investigated. The new problem involved moving coal from where the freighters discharged it to a point 250 or 300 ft away, and storing it in such a manner that additional handling would not be necessary, and it could safely be allowed to remain in such storage for many months.

Coal is now stored in horizontal rather than oblique strata. This eliminates the formation of flues and reduces the fire hazard. There is little need to fear spontaneous combustion since coal is packed so tightly that little of the fire-breeding oxygen can filter in. In the three years that Dow has been storing its coal thus, no rises in temperature have been noted, even after 18 months of continuous storage.

Since this method of piling coal gives an extremely compact flat plateau, it is necessary to round off the top to insure proper drainage. With the correct pitch it is possible to achieve this with no appreciable increase in moisture.

Coal Moving

For loading, transporting and compacting, one Caterpillar tractor hauling a carryall and shoving a bulldozer is used. This unit handles an average of 130 tons per hour. The cab is equipped with a heating and air-conditioning system of the company's own design and has other unique features that contribute to the comfort of the operator.

Another costly item in many coal-handling programs is the freezing of coal to the sides of hopper-bottom railroad cars. To prevent this, the insides of cars during cold weather are sprayed with a solution of Dowflake calcium chloride, non-freezing even at temperatures well below zero Fahrenheit.

Spraying inside of cars with calcium-chloride during cold weather prevents freezing

Air Conditioning the Disney Studios

Walt Disney examines one of the conditioning units serving the Animation Bldg

For new studio-home of Mickey Mouse and Donald Duck, engineers have designed a unique system providing zoned comfort conditioning in 300 offices, "superclean" air for camera and cutting rooms, "silent" air for big sound stages

▶ USED IN THE CREATION of Pinocchio, now delighting movie-goers in all corners of the U. S., and formally opened in March, the first completely air-conditioned studio city stands in the San Fernando Valley in Burbank, Calif.—a new and comfortable home for Mickey Mouse, Donald Duck, and all the other famous Walt Disney characters. Designing a system to serve 14 buildings with specialized functions, scattered over 51 acres, meant solving varied problems in process and comfort cooling.

To start on the right foot, General Electric and Disney engineers made comprehensive weather studies before starting the job, since the wide climatic variations which occur a few miles from the coast made it unsafe to base the design on dry- and wet-bulb standards applying in Los Angeles. Fortunately, extensive weather data was available at the nearby Union Air Terminal. These records were made the basis of an exhaustive study of heating, cooling, drying, and humidifying requirements.

Engineers carefully weighed the frequency and duration of extremely high temperature conditions and occasional sub-freezing night temperatures, to provide essential comfort without unnecessarily enlarging the plant. The study also showed that for many of the process rooms, humidifying and cooling would sometimes be needed concurrently, a departure from normal cooling practice.

Before construction was begun, the engineers built a full-scale test room to study and check methods of air distribution. In the actual buildings, air flows are individually adjustable for the space served and delivery into the rooms can be directed both horizontally and vertically in order to give correct distribution.

The system finally laid out for the studios features a central plant to generate hot and cold water for distribution to individual conditioners in different buildings and parts of buildings. A few small isolated buildings have completely independent air-conditioning arrangements. A 600-hp G-E multiple condensing-unit plant forms the heart of the central station, with two 1900-sq-ft gas-fired boilers for heating. A natural supply of 67-F water materially reduces operating cost and size of heating and cooling installation by precooling air on hot days and preheating it on cold days. Including the refrigeration effect of the well water, the total tonnage of the job amounts to 1400 and approximately 1300 hp of motors drive blowers, pumps and compressors.

Animation Building

The Animation Bldg, largest on the grounds, houses some 900 creative artists who "animate" the characters in Walt Disney productions. Built with 8 wings extending 4 on each side of a central tier, this structure comprises over 300 individual offices with a total floor space of 150,000 sq ft. An individual conditioner unit supplies each wing.

In the Animation Bldg, no room air recirculates; conditioners receive all fresh air from a level far above the ground. After passing through cleanable viscous-coated filters, the air comes to well-water coils which preheat when air is below about 65 F and precool when it is above 70 F. Next, vapor-jet humidifiers increase the moisture content when necessary, after which the air stream divides, part passing through hot-water coils to a hot plenum, and part through refrigerated-water coils to a cold plenum.

Each wing contains many rooms having different exposures, occupancies and internal loads. Rooms with similar conditions are grouped on individual supply ducts with a separate control for each zone. Proportioning dampers blend warm and cool conditioned air from the two plenum chambers to maintain a constant flow of air having the required temperature and humidity. There are 165 independent thermostatic control stations in the Animation Bldg, giving accurate regulation in all parts even under conditions of quick and extreme load change.

William Garrity, Disney chief engineer, explains how one of the new lighting and air-distribution fixtures works

Special combination "air-light" fixtures deliver conditioned air to the individual rooms in an even film across the ceiling, at the same time providing high-level illumination for the artists. Air moves slowly and without draft to continuous baseboard grilles which also embody open-face conduits for light, telephone, and signal wiring, and compressed-air lines for artist's air brushes. Exhaust fans expel "used" air outdoors, and assure adequate delivery of fresh air by eliminating dependence on variable building air leakage.

Superclean Air

Conditioning of the Camera Bldg aims at perfect air cleanliness, to protect against particles of lint and dust on paintings, which might, when photographed, produce harmful light effects. Attendants keep camera rooms scrupulously clean and carefully wax the floors. Operators wear special "lintless" clothing, and enter the camera rooms through a "de-dusting" chamber where high-velocity air jets blow particles of lint and dust from their clothes. This air is drawn off through a floor grating and is routed to the motor-generator room where it cools the sets supplying current for the cameras.

In the camera rooms, designers faced the problem of getting rid of as much as 70 kw of heat from a single camera, without drafts. Where possible, exhaust hoods draw off air at points of heat concentration and multi-outlet air distribution permits delivery of required cooling effect without drafts. Incidentally, the air used for some of the general conditioning in the Camera Bldg passes to the "de-dusters" and to the mg sets, doing a 3-part job.

Two banks of cleanable viscous-coated filters cleanse camera-room air so thoroughly that white fine-mesh cloth mats placed directly before the air-delivery grilles for 5 hours show no sign of lint or dirt. Similar methods produce the same result at the Cutting Bldg.

In the storage vaults, all paintings on celluloid are kept at even temperatures and humidities to guard against disturbing the all-important registry of sequence drawings. In addition, correct air conditions protect the paint from deterioration.

Wherever inflammable film is handled, as in the Cutting Bldg, automatic fire dampers protect air-inlet and exhaust openings. Fusible links hold the dampers; the links would break readily if a fire should start, preventing inlet air from feeding the flames and keeping the smoke and heat out of the return system.

On this big sound stage, conditioned air enters through slots between convolutions of the ceiling; exhaust air leaves through grilles under platform risers

On the Orchestra Stage of the new Disney studios, a special acoustic shell backs up the orchestra to provide maximum brilliance of sound without echo or distortion. The fact that large groups of musicians or single performers may use the stage requires controllable as well as even air distribution. Building the entire space above the acoustic shell air-tight permits this. The conditioning system fills the space with air under slight pressure. Released to the stage through a series of slots behind the convolutions in the shell, the air exhausts evenly through grilles in each platform riser, below.

In the Orchestra Stage and the smaller Dialogue Stage, designers took special precautions to suppress or prevent noises which would interfere with making satisfactory recordings. The nearness of Union Air Terminal, at Burbank, necessitated careful sound baffling of the large air-distribution ducts, to eliminate the roar of large transport planes which sometimes climb directly over the studio. Carefully selected blowers, low air velocities, acoustically-treated ducts and sound traps all contribute toward keeping the noise level exceptionally low.

Automatic-compensated thermostats regulate summer cooling to match outside conditions, rather than to maintain constant inside temperatures. If outdoor temperature is at 74 F, the conditioning system produces no cooling effect; if temperature goes to 98 F, the units provide cooling enough to hold indoor temperatures to 78 F. This 20-F difference between inside and outside temperatures is the maximum permitted. Winter and summer temperatures as well as winter and summer humidities are controlled independently wherever required, and all change-overs from winter to summer control conditions are performed automatically as the weather changes.

The engineer in the central plant can determine individual air-conditioner operation in all buildings by means of indicating lights. Further, he can check temperatures and humidities at various points in the buildings by a meter indicating board.

Safe Painting Steel Stacks

Steel stacks, large or small, occasionally need paint or repair but the job gets put off as long as possible because most of us develop a sudden attachment for terra firma. Some ideas about safe scaffolding that have been proved in practice are explained here by W Elwood Rossnagel, safety engineer, Consolidated Edison Co of N. Y.

▶ PAINTING AND REPAIRING STACKS are jobs that give maintenance men headaches in large plants as well as small ones. The usual sad state of stack repair can hardly be held against the average operating crew who have never been up a stack and hope never to have to go. One look at a rusty steel cable hanging from the top of a stack convinces most men they were not born to be steeplejacks.

Most new stacks are provided with a heavy steel hook over the crown with a steel pulley block attached. Galvanized steel cable, called a gantline, is reeved through the pulley block. After several years exposure to rain and flue gas, the condition of hook, block and gantline are a matter of hope, not certainty. The next step is to attach a simple boatswains' chair to the gantline and hoist a man to the top carrying a new gantline hook and a set of manila-rope falls. If he gets to the top on the first trip, it can be assumed all is well!

Not long ago, a painter, on reaching the top of a stack in this conventional manner, discovered that the hook on the pulley block on which his life depended was very badly pitted and corroded. He managed to get down without mishap but the experience led him to work up a device to enable a man to reach the top of a small stack in safety A forged steel bar, Fig. 1, is fastened to the existing gantline by the middle eye. A set of manila-rope falls that has just been inspected and found in safe condition is attached to the eye at the base of the hook and the hook of the pulley block is "moused" to prevent accidental detachment. A tag line is finally tied to the end eye and the entire rig hoisted by the gantline. When raised to the extreme position, the gantline is held stationary, while a slight pull on the tag line tilts the bar so that the hook engages the top of the stack.

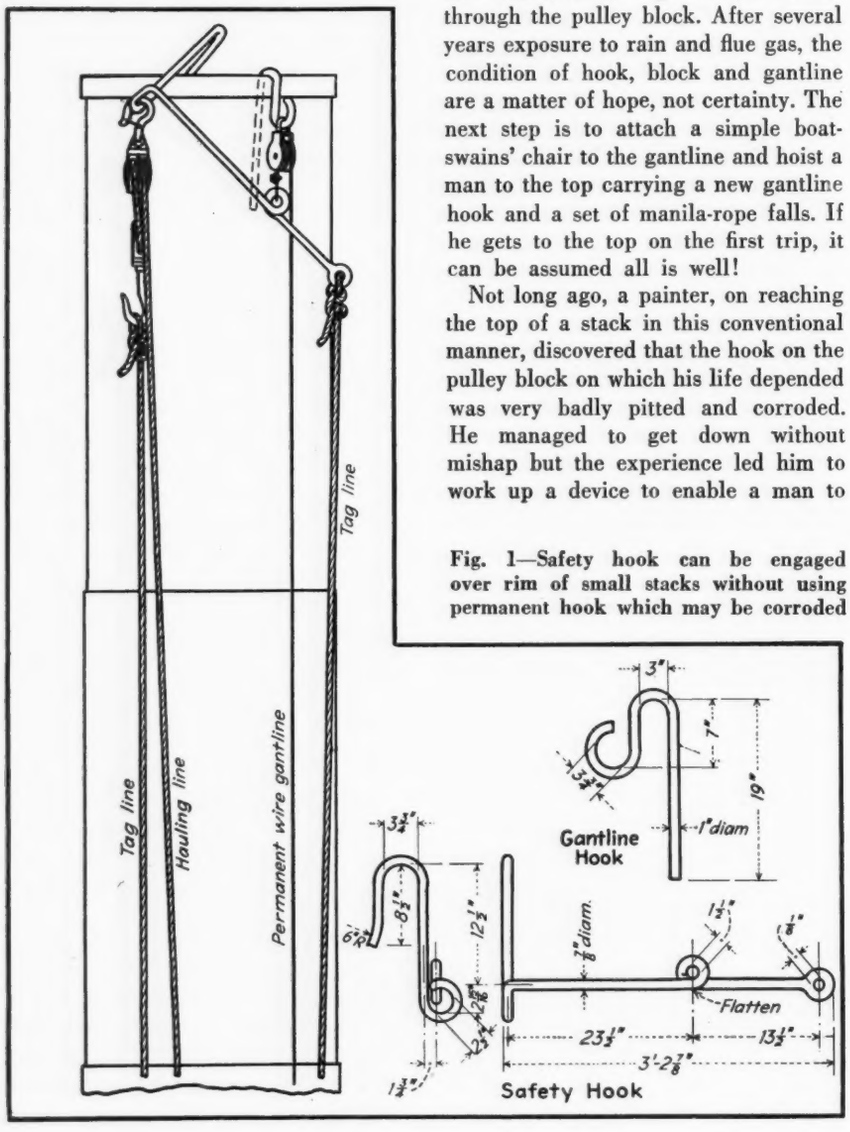


Fig. 1—Safety hook can be engaged over rim of small stacks without using permanent hook which may be corroded

The rope falls, which were hoisted in a "block-and-block" position, are pulled down by another tag line. Then a "bos'n's" chair, preferably a safety type with body belt, is attached and a painter can hoist himself to the top without trusting equipment he can't inspect.

Steel Ladders

Intermediate-size stacks usually have permanent steel ladders 18 in. wide, 12-in. rung spacing and 6½-in. toe room behind the ladder. Because they are exposed to weather and corrosion, rungs should be not less than ¾-in. diameter and the stringers at least 3 x ½ in. Basket guards, Fig. 2, allow a man to climb in comparative safety but, because of their size in comparison with the stack, are seldom used on any except very large stacks.

An alternate to basket guards is a bronze or galvanized cable stretched up each side of the ladder, Fig. 3. These cables are anchored alternately by passing through eyebolts every 30 ft and pulled taut by turnbuckles. In climbing, a man wears a life belt equipped with two forged-steel (not malleable iron) snap hooks. With both hooks snapped on the cables at the start, he detaches one hook at a time as he passes each eyebolt.

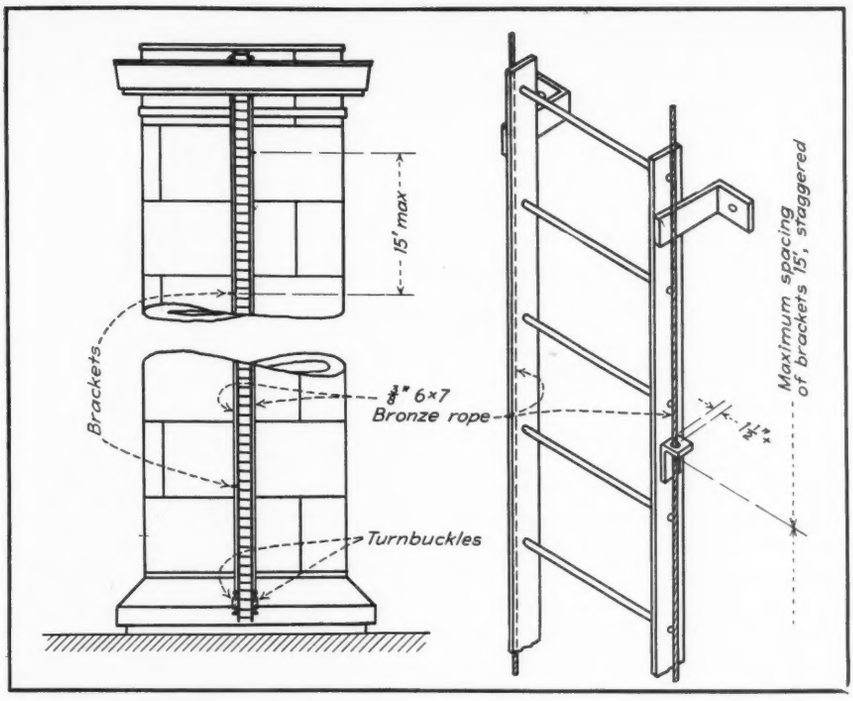


Fig. 3—Bronze wire ropes attached to ladders by staggered brackets make possible the use of a life belt. These cables are anchored alternately by passing through eyebolts every 30 ft and pulled taut by turnbuckles

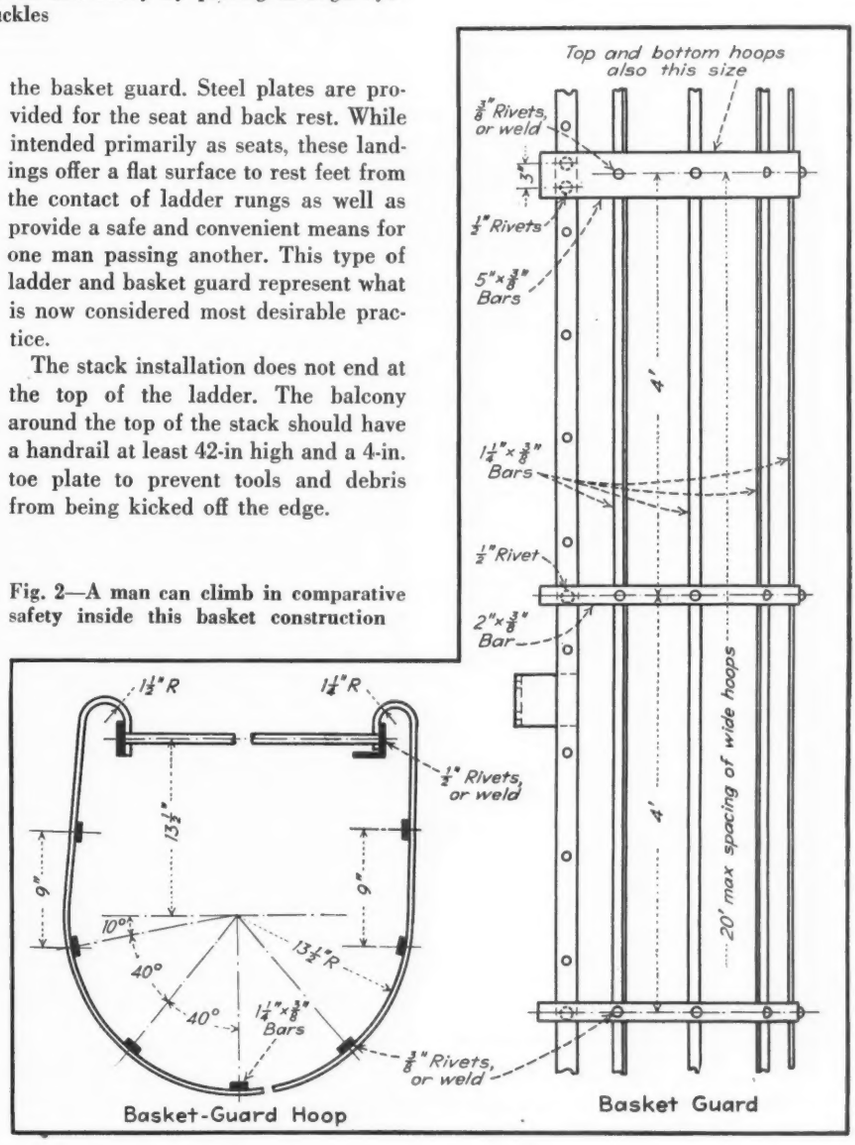
Following this procedure to the top, there is never a time when the man is not protected by at least one hook. If he gets tired or dizzy, he can attach one of the hooks to the ladder rung and rest. It is admitted that use of such equipment is largely psychological, but should a man begin to fall, he will be held close to the ladder and will have a better chance of grasping it again. In no case can he fall more than 15 ft because of the alternate eyebolts. Another advantage of this particular equipment is that a man must stop and rest every 15 ft, even though it may be for only a few seconds. Some riggers take pride in claiming ability to climb a 250-ft stack without resting but they do not tell how near they came to having a cramp in an arm or finger muscle that might have had fatal results.

Ladders on some stacks are placed about 27 in. away from the stack wall so that a man can climb the inner side of the ladder and lean his back against the stack to rest. A further improvement is the installation of guard bars, Fig 4, to complete the enclosure of the ladder. With the spacing shown, protection is afforded against being blown off in a high wind but a man can climb out onto a scaffold through the bars if necessary.

One new stack is 21-ft diameter at the top and 31-ft at the base, Fig 5. The ladder shown is over 300-ft high and equipped not only with a standard basket guard but special seats at 50-ft intervals formed by offsetting the bars of the basket guard. Steel plates are provided for the seat and back rest. While intended primarily as seats, these landings offer a flat surface to rest feet from the contact of ladder rungs as well as provide a safe and convenient means for one man passing another. This type of ladder and basket guard represent what is now considered most desirable practice.

The stack installation does not end at the top of the ladder. The balcony around the top of the stack should have a handrail at least 42-in high and a 4-in. toe plate to prevent tools and debris from being kicked off the edge.

Fig. 2—A man can climb in comparative safety inside this basket construction



Provision should be made for inspecting the upper portion of the stack lining. If the balcony grating is too far below the top of the stack proper to permit inspection of the inside, checker-plate steps can be placed at convenient points. Eyebolts just below the stack crown ring allow attaching snap hooks of the body belt to give protection against falling either inside or outside the stack.

Painting Large Stacks

For painting large stacks, an articulated circular scaffold has proved both adaptable and useful. Twelve trapezoidal platform sections form a scaffold completely around the stack except at the ladder. By using only nine of the sections, a scaffold can be constructed for use inside the stack such as in repairing the lining.

At each joint between sections and on either side of the ladder standard Patent Scaffolding Co hand-operated scaffold winches support the structure.

Each is provided with the requisite length of $\frac{5}{16}$-in., 6 x 19, galvanized wire rope attached to special bent-plate anchors resting on top of the stack wall.

From plate brackets at each winch frame, two suspender bars support adjacent platforms. Thus supported and tied loosely together, the scaffold is sufficiently flexible that one winch can be elevated as much as a foot or more above the next. Thus it is not absolutely necessary to man each winch simultaneously nor to "pump" the winches exactly in unison.

Safety Features

Safety has been a primary consideration in the design of this scaffold. If, by some stretch of the imagination, we conceive of 12 out of 13 cables failing simultaneously, the remaining cable will cause the circular scaffold to tilt as a unit and bind on the stack. No hanging life lines are used as continuous manila ropes form an outboard hand rail and the space between scaffold and stack wall is too small to fall through.

Winch parts are doubly protected against failure, there being duplicate dogs on the lowering motion, main dog and worm drive on the hoist motion. Two of these devices would have to fail simultaneously to allow the winch to unwind by gravity. To insure winding the suspension cable in even layers on the drum during the hoisting operation, a fairleader actuated by a traveling nut on a lead screw feeds the cable on the drum.

When used inside the stack, a lesser number of the same platforms form the necessary smaller circle, and the winches are reversed to put the levers and rope rail on the inboard side. The hazard from falling brick chips inside the stack cannot be completely eliminated and safety hats, shoulder pads or other protection should be provided.

Painting Time

This type of scaffold has been in use about eight years with minor modifications from time to time to add to the convenience of the men. It has met unanimous approval of painters and construction men alike wherever introduced.

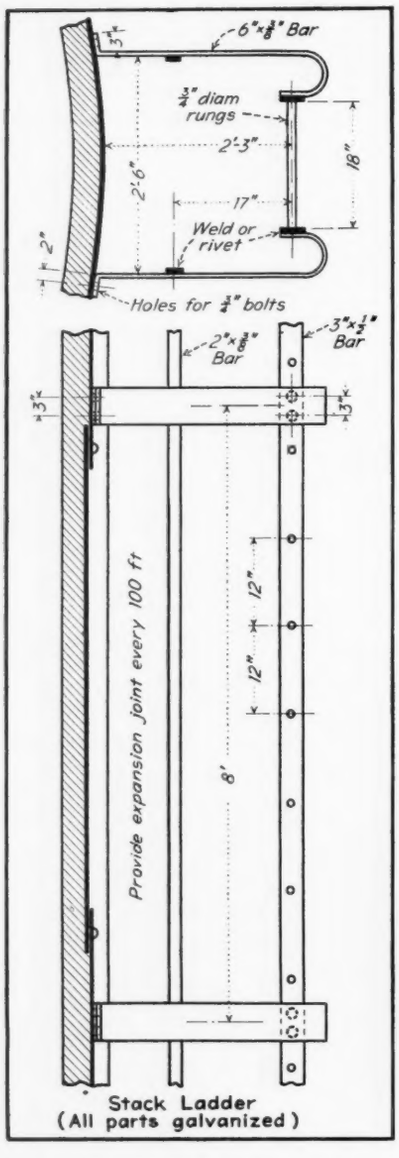


Fig. 4—Supporting the ladder 27 in. out from the stack forms an enclosure inside which a man can stop to rest

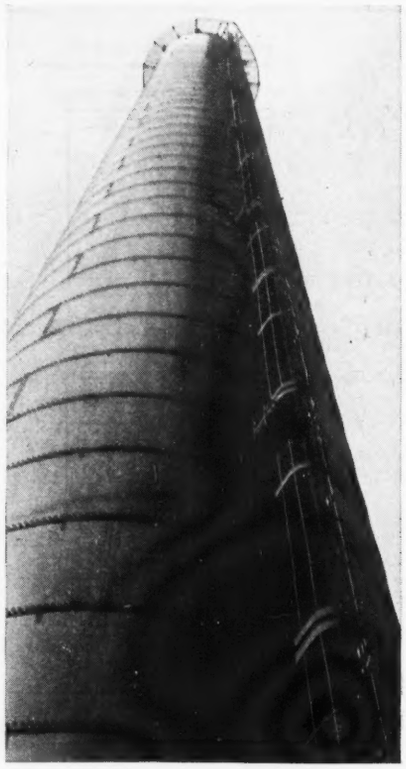
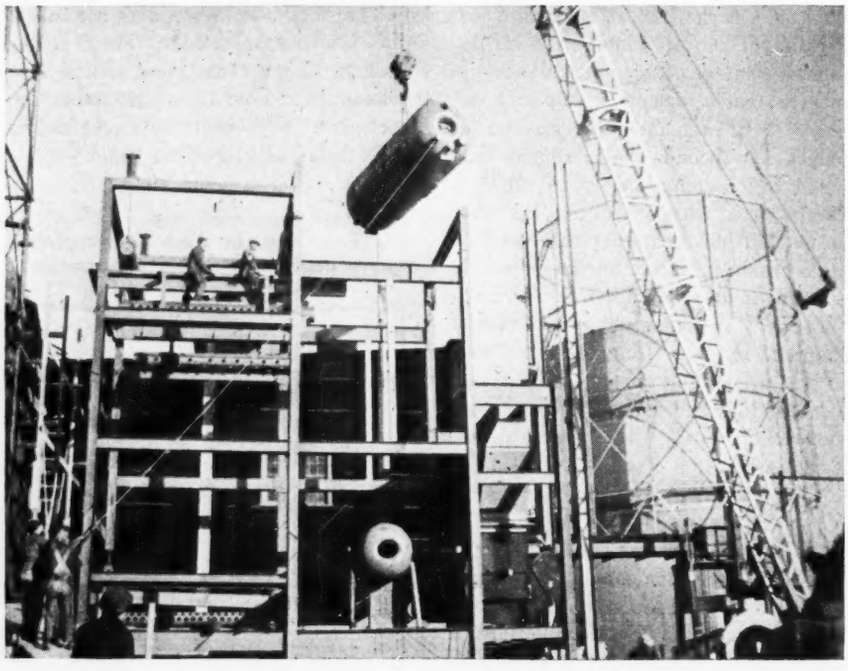


Fig. 5—300-ft ladder with built-in seat enclosures at 50-ft intervals formed by offsetting bars of the basket guard

Editor's Note: Details of the scaffold construction mentioned in this article will appear in an early issue of POWER.

NORWICH PLANT EXPANDS



A new 100,000-lb-per-hr Riley boiler to deliver 900-lb, 750-F steam to a 10,000-kva GE turbine-generator is being erected for the municipal lighting department of this Connecticut city for service this summer. A 100-ft stack and Westinghouse condenser are included in the installation. Arthur J. Nelson Engineers, Boston, are consultants

A Place in the Sun for St Louis

A fact-finding Committee, business men, a doctor and a smoke commissioner report ways and means of eliminating smoke problem. Here is what they propose to do

▶ When the Mayor and the people, the Smoke Commission and the Chamber of Commerce, the coal men and the engineers all get together and wade in, even a serious smoke problem appears to have a reasonable solution. Smoke has been front-page news in St Louis all winter.

Now, with all the facts marshalled in a comprehensive report and legislation in prospect to back up the recommendations, the stage is set, the first act is on, and by the end of 1942 another city will be a brighter, better, healthier place to live and do business.

Why is smoke elimination news? Hasn't the good work been going on for years, ever since Pittsburgh decided it could no longer afford its blanket of "smog"? Well, the news is the report the Committee handed the Mayor, bringing years of smoke elimination study and experience to bear on a specific case problem.

Root of the Problem

The root of the problem stems from the nearness of the Illinois high-volatile-coal fields. St Louis buys its coal more cheaply than most other cities of similar size, but the high-volatile product of the Illinois mines requires either mechanical fuel-burning equipment or very careful hand firing to prevent smoking.

Practically any change in the existing situation will involve higher fuel costs for the ultimate consumer. Someone will have to pay for freighting low-volatile coal from West Virginia or processing Illinois coal or for mechanical equipment to burn Illinois coal smokelessly.

Many possible solutions went through the Committee mill. Education and policing are successful when applied to power boilers mechanically fired, fail miserably when applied to the distasteful morning chore of firing a home heating furnace or a kitchen stove. Subsidizing all consumers by paying the processing cost in one way or another has its dangers as well as the disadvantage of discouraging natural development of firing equipment. Natural-gas heating for homes sounds attractive but exclusive application to an entire city requires a large expenditure for mains that serve only a few months a year. Furthermore, gas would have to sell at less than half its present relatively low price to compete with present coal prices.

District heating now supplies the downtown district with steam enough to replace 100,000 tons of coal annually. Investment cost in plant and mains would be out of the question for less concentrated areas.

Of course the proponents of a municipally owned gas, coke and fuel-processing plant have had their hearing too. The committee states that it would unhesitatingly recommend such a plant if no other method would accomplish equal results at lower cost to the taxpayers.

As this issue of Power goes to press, the enabling legislation, in accordance with the simple principles listed below, has been passed by the Board of Aldermen, the Division of Smoke Regulation is being recast to suit its increased responsibilities and only time seems to stand between St Louis and a well deserved share of sunshine.

THE PRINCIPLES

First — That all those who desire to burn high-volatile fuel must employ mechanical fuel-burning equipment to burn it smokelessly.

Second — That those who do not desire to use mechanical fuel-burning equipment must use a smokeless fuel.

THE COMMITTEE BELIEVES

1. It is unsound for a city to rely on a single source of fuel supply and one character of fuel, as would result from a municipally owned fuel-processing plant.
2. The problem will be better solved by a diversification of smokeless fuels and the sources of their supply.
3. A municipal plant would stifle the interest of private capital in several processes now available.
4. If the interest of private capital is destroyed, hope vanishes for improved products and new processes resulting from research work sponsored by that private capital.
5. Under the stimulus of an ordinance automatically requiring the use of a smokeless fuel, there will be, in the course of time, plenty of smokeless fuel available.
6. Municipal investment of millions of dollars in a single huge processing plant might become worthless in a short time.
7. It is unnecessary to hazard the taxpayers money when indications are that private capital is available.

Economizers Make No Noise

All the advantages of a forced-circulation boiler but none of the troubles. Simple curves shown here throw new light on the old problem of what an economizer can do for you

► AN ECONOMIZER used to be a simple sort of box hung in the boiler outlet with feedwater piped through and flue gas from the boiler outlet flowing crosswise across the tubes. By transfer of heat through the tube walls, good Btu's that would otherwise be wasted up the stack were returned to the boiler drum, and boiler efficiency went up several points.

The idea hasn't changed, but the application has become much more complex. In some new boilers, economizer surface exceeds boiler surface. This condition results from two well-known facts. First, economizer surface costs less per sq ft than boiler surface and, second, generally speaking, the higher the boiler pressure the more economizer surface can be usefully employed.

For example, at 200-lb pressure, temperature of the water circulating in boiler tubes is 387 F; at 1200-lb, the corresponding temperature is 568 F. If two boilers are designed for these pressures, each having enough surface to bring the flue gas to within 100 F of the water temperature, flue gas will leave the low-pressure unit at 487 F and the high-pressure unit at 668 F. The high-pressure boiler has a 180-F higher "dry-gas" loss than the low-pressure, or a 6% lower efficiency.

Limitations on Use

Even a small increase in operating pressure adds considerably to the need and the economic justification for some type of heat-recovery apparatus. Either an economizer or an air preheater or both may be the answer. The limitation on the use and size of economizer is measured by the difference between temperature of feedwater leaving the final feedwater heater and that of the water in the boiler drum. Obviously, only as much heat can be recovered by an economizer as can be used to heat feedwater between these limits, unless the economizer is specifically designed to produce steam. While steaming economizers are quite practicable and a number are in use, their application has not become widespread.

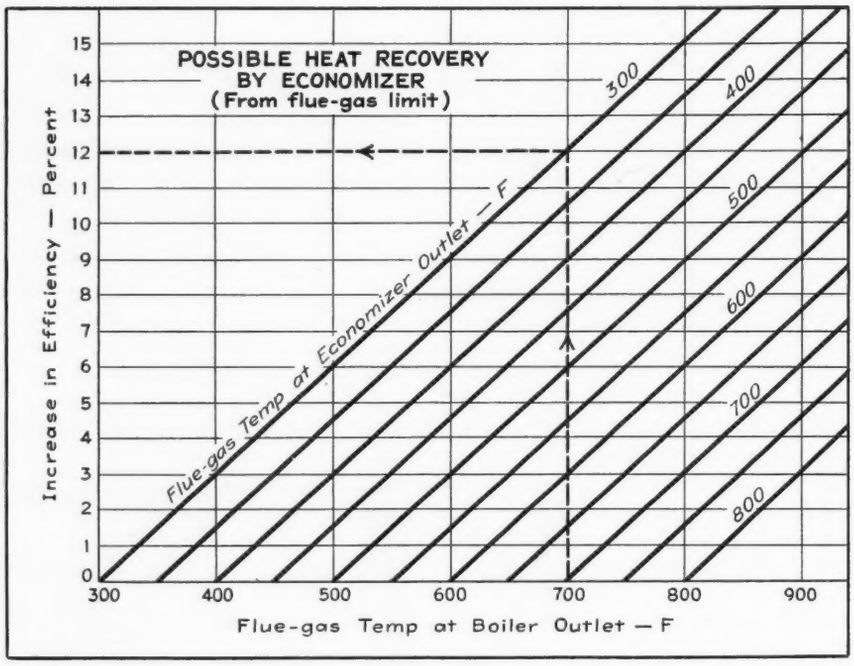


Fig. 1—If flue-gas temperatures limit heat recovery, possible increase in efficiency is found from these curves which tell maximum feasible size

Air preheaters, principal competitors as well as working partners of economizers, likewise are subject to limitation. Ordinarily, for low-pressure boiler plants, either an economizer or air preheater alone will reduce flue-gas temperature to the economic limit. In this case, usually smaller plants, the economizer is selected because it does not introduce the complication of preheated air under stokers.

Large high-pressure boilers can economically employ the largest economizer possible, that is, one which heats the feedwater to within about 25 F of drum temperature, and also that size air preheater which will cool the flue gas down as near the dew point as is considered safe. The air preheater always follows the economizer; flue gas passes first through the economizer.

To determine approximately how much higher efficiency of the boiler plant can be obtained by installing an economizer on an existing boiler or including one in a new-boiler project, two simple charts give a first approximation. Fig. 1 charts the number of points of efficiency gain, 5 points being the difference between 75% and 80% efficiency, for example, that an economizer will gain for you if flue gas is cooled from some existing or proposed temperature along the base line to some lower temperature on one of the chart lines.

In an existing installation, for instance, where flue-gas temperature averages 700 F, an economizer that reduces the stack exhaust to 300 F will add 12 points to the boiler efficiency, and, incidentally, the same relative amount of increased steaming capacity from the same fuel-burning equipment.

However, it is sometimes improper to install as great an amount of economizer surface as would appear desir-

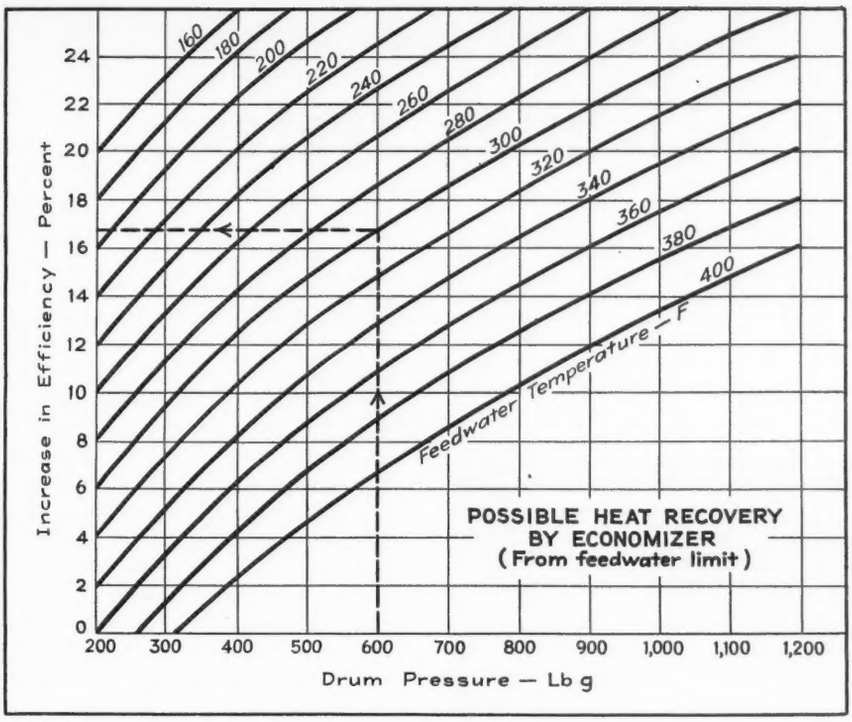


Fig. 2—Feedwater temperature and drum pressure also limit possible heat recovery by an economizer. If more heat is available than an economizer can use, an air preheater following the economizer can get the rest

able from Fig. 1. For checking the amount of heat that can be picked up by the feedwater in being heated to 25 F less than drum temperatures, Fig. 2 tells, for any operating pressure, how much efficiency gain you get from the maximum size economizer that can be installed. For example, a 600-lb boiler supplied with 300-F feedwater can use an economizer up to 16.7% heat recovery or efficiency increase, providing, of course, that flue-gas temperature will not thereby be too greatly reduced. Since both Figs. 1 and 2 tell the maximum size you can install, whichever gives the smaller result becomes the maximum.

Having found the size economizer that can be installed in terms of efficiency improvement, there remains the work of calculating whether the coal saving or increased output from existing fuel-burning equipment will pay for the cost of economizer plus installation. The heat gain in terms of efficiency, flue-gas temperature, and the steam flow are enough information to obtain an approximate set of dimensions and price for an economizer.

Opinions vary widely on how much time a coal saving should have to run to pay for an added investment. For a new installation, five to ten years may represent an attractive proposition; for a modernization program, three to six years is somewhat more safe.

Economizer construction has been standardized by each of several manufacturers. Steel tubes with or without some form of "extended" surface are universal in contrast to the cast-iron units of a dozen years ago. Extended surface, consisting of cast-iron rings or plates shrunk on the steel tubes, (POWER, Feb, 1937) or steel fins welded along top and bottom of each tube, increase the area exposed to flue gas and thereby increase the heat transfer per unit tube and per unit of cubic space occupancy.

Bent-tube economizers usually accompany only bent-tube boilers as two drums are required, all tubes being rolled into these drums. Straight-tube economizers are less expensive and more numerous. The latter can be supplied with return bends welded to the ends of tubes forming several single-tube paths for water flow from inlet to outlet header without gasketed joints. This type cannot be cleaned by mechanical methods, but where feedwater treatment is adequate and make-up is low it is practically trouble-free.

Where cleaning is necessary, gasketed return bends are furnished. These consist either of box headers, with hand-hole caps, into which tubes are rolled, or of flanged 180-deg U's of heavy bolted construction.

Economizer troubles are not numerous but can be serious. If there is dissolved oxygen in the feedwater, it attacks the economizer tubes first as it passes over them before contacting the drum and boiler tubes. Good deaeration of the feedwater is the obvious cure. Scale formation in economizer tubes indicates lack of necessary feedwater treatment; the economizer should not receive entire blame for this troublesome problem as the same scale would inevitably form on boiler tubes which are more difficult to clean.

Exhaust Lines

By L N ROWLEY

Operators at the Central Heating Plant of the U. S. Public Buildings Administration in Washington, D.C., overcame excessive breakage of steel rapper bars in electrostatic precipitators by replacing with bars of 18-8 stainless.

Most of us think of a condenser as something hitched to a turbine or engine, but, of course, that's not the only place a condenser finds use around a power plant. G G Hollins, of J G White Engrg Corp, speaking to the Power Division of the Metropolitan ASME, told of a plant where installing a condenser on a 30-lb steam header, to take care of excessive low-pressure steam, improved operation and produced worthwhile savings.

To study boiler foaming right on the spot, the Electro-Chemical Engrg Corp of Chicago fitted a Missouri Pacific locomotive with a 1000-watt GE lamp in the steam dome and another in the boiler roof. One side of the circuit was grounded, the other brought in through a special gland. The camera shot the "inside story" through a heavy glass bull's eye in the steam dome.

When I passed through Apalachicola, Florida, last year on my way to the new paper mill at Port St Joe, I didn't realize it was the home of Dr John Gorrie, pioneer in refrigeration. According to Scientific American, the doctor became convinced that air cooling rooms would help in his fight against fever and devised a simple unit using ice. However, in a land where ice was unavailable there was nothing for the doctor to do but turn to ways of producing it mechanically. He worked out a compressor unit, using air as refrigerant, and in May 1851 received the first U.S. patent on apparatus for mechanical ice production.

Designing a Lighting System

Second of two articles by Dean Warren, General Electric Co, shows how to plan a lighting installation. Tables suggest various types of equipment to use for best results

Fig. 1—Continuous trough of control lenses, behind a truss, lights this turbine-control board to a 30-footcandle level without reflections or glare on meters and gages

▶ IT IS GENERALLY RECOGNIZED that installing a lighting system is the particular function of the illuminating engineer. His experienced judgment, plus measurement with the proper instruments, enables him to design a lighting installation under which the eye can function with ease and efficiency. However, it is desirable that everyone concerned with an installation—those who must work under it, those who must supervise the work, and those who must justify the expenditure—should have a general knowledge of the lighting problem.

Light Needed Varies

To maintain good seeing conditions, it is essential that artificial light be supplied when daylight fails, on dark and cloudy days, and for areas where an insufficient amount of daylight penetrates. Actually, where rooms are illuminated through side windows, daylight falls off so rapidly toward the center of the room that those working 20 ft from the windows may receive only 5 footcandles, whereas those who work near the windows may receive several hundred.

Modern practice requires the establishment of a base or minimum quantity of light throughout the room, termed general lighting. This of course varies, depending on the visual severity of the task. (A table showing values for different operations was published on page 73, April POWER). Where visual tasks are particularly

TABLE I—SPACING OF LIGHTING OUTLETS

Ceiling height (or height in the clear)	*Spacing between outlets*		*Spacing between outside outlets and wall*		*Approx area per outlet (at usual spacings)*
	Usual	*Max (for units at ceiling)*	*Aisles or storage next to wall*	*Max (desks, etc. against wall)*	
(Feet)	*(Feet)*				*(Sq Ft)*
8	7	7½	Usually	3	50–60
9	8	8		3	60–70
10	9	9	one-half	3½	70–85
11	10	10½		3½	85–100
12	10–12	12	actual	3½–4	100–150
13	10–12	13		3½–4½	100–150
14	10–13	15	spacing	4–5	100–170
15	10–13	17		4–5	100–170
16	10–13	19	between	4–6	100–170
18	10–20	21		4–6	100–400
20	18–24	24	units	5–7	300–500
20 & up	20–30	30		5–7	400–900

TABLE II—CLASSIFICATION OF INTERIORS

Approximate proportions of room	*Color ceiling and upper sidewalls*	*CONDITIONS FACTOR*	
		Direct-Lighting	
		Maintenance	
		Very good	*Fair*
Width 4 times ceiling height	Light	A	A
	Medium	A	A
	Dark	A	B
Width 2 times ceiling height	Light	A	B
	Medium	A	B
	Dark	B	C
Width equal to ceiling height	Light	B	C
	Medium	C	C
	Dark	C	C

TABLE III—ILLUMINATION VALUES CALCULATED FOR VARIOUS LAMP SIZES IN VARIOUS EQUIPMENT TYPES

Area per outlet adequately lighted — or approx spacing	*Minimum distance from underside of reflector to floor*	*Conditions factor*	*Direct lighting equipment for low mounting such as Glassteel & RLM-type fixtures — industrial average footcandles*					*Direct lighting fluorescent*	*Direct lighting high bay fixtures — industrial average footcandles*				
			200-Watt	*300-Watt*	*500-Watt*	*750-Watt*	*400-Watt Merc*	*85-Watt RF Lamp*	*500-Watt*	*750-Watt*	*1000-Watt*	*1500-Watt*	*400-Watt Merc*
55–65 Sq Ft or 7¾′ x 7¾′	7′ 6″	A B C	18–23 14–18 11–14					30–36 24–30 18–24					
65–75 Sq Ft or 8½′ x 8½′	8′ 6″	A B C	15–19 11–15 9–11	24–32 17–24 14–17				26–31 21–26 16–21					
75–85 Sq Ft or 9′ x 9′	8′ 6″	A B C	13–17 10–13 8–10	21–28 17–21 13–17				23–27 18–23 14–18					
85–95 Sq Ft or 9½′ x 9½′	9′ 0″	A B C	12–15 9–12 7–9	21–25 15–21 11–15	35–41 27–35 20–27			40–48* 32–40* 24–32*					
95–110 Sq Ft or 10′ x 10′	9′ 6″	A B C	11–13 8–11 6–8	18–23 13–18 11–13	31–38 25–31 20–25	48–61 34–48 30–34		35–42* 29–35* 22–29*					
110–125 Sq Ft or 11′ x 11′	10′ 0″	A B C	9–11 7–9 5–6	15–19 11–15 9–11	27–32 20–27 15–20	40–51 30–40 22–30		31–38* 25–31* 18–25*					
125–145 Sq Ft or 11½′ x 11½′	10′ 6″	A B C	8–10 6–8 5	13–17 10–13 8–10	23–30 18–23 14–18	36–46 27–36 21–27							
145–170 Sq Ft or 12½′ x 12½′	11′ 6″	A B C	6–8 5–6 5	12–15 9–12 7–9	21–25 17–21 13–17	31–39 24–31 19–24	33–40 27–33 21–27						
170–200 Sq Ft or 13½′ x 13½′	11′ 6″	A B C	6–7 5	10–12 7–10 6–7	18–23 14–18 10–14	27–34 19–27 15–19	28–33 23–28 18–23						
200–230 Sq Ft or 14¾′ x 14¾′	12′ 6″	A B C	5–6	8–10 6–8 5–6	15–19 12–15 9–12	22–28 16–22 14–16	24–29 20–24 15–20						
230–260 Sq Ft or 15½′ x 15½′	13′ 0″ (High Bay 15′)	A B C	5	7–9 6–7 5	13–17 10–13 8–10	19–25 15–19 12–15	22–25 17–22 14–17		17–19 14–17 12–14	24–28 20–24 17–20	33–37 28–33 23–28	55–62 46–55 38–46	27–31 23–27 19–23
260–300 Sq Ft or 16¾′ x 16¾′	13′ 6″ (High Bay 16′)	A B C		7–8 5–6	12–15 9–12 7–9	18–22 14–18 10–14	19–23 15–19 12–15		15–17 12–15 10–12	22–25 18–22 15–18	29–33 24–29 20–24	48–55 41–48 34–41	24–27 20–24 17–20
300–340 Sq Ft or 18′ x 18′	14′ 6″ (High Bay 17′)	A B C		5–7 5	10–12 8–10 6–8	15–18 12–15 9–12	16–20 13–16 10–13		13–15 11–13 9–11	19–22 16–19 13–16	26–30 22–26 18–22	43–49 36–43 30–36	21–24 18–21 15–18
340–390 Sq Ft or 19′ x 19′	15′ 6″ (High Bay 17′)	A B C		6	9–11 7–9 5–6	14–16 10–14 8–10	14–17 12–14 9–12		12–14 10–12 8–10	17–20 14–17 12–14	23–27 20–23 16–20	39–44 32–39 27–32	19–22 16–19 13–16
380–440 Sq Ft or 20′ x 20′	17′	A B C							11–12 9–11 8–9	16–18 13–16 11–13	21–24 18–21 15–18	35–40 20–35 24–29	17–20 14–17 12–14
440–530 Sq Ft or 22′ x 22′	18′	A B C							9–10 7–9 6–7	13–15 11–13 9–11	17–20 14–17 12–14	29–33 24–29 20–24	14–16 12–14 10–12
530–625 Sq Ft or 24′ x 24′	22′	A B C	Note: These columns are calculated for Glassteel Diffusers; for RLM dome reflectors add 10% to obtain the approximate footcandle reading.					* Two 85-watt lamps at each outlet	8–9 6–8 5–6	11–12 9–11 7–9	15–17 12–15 10–12	24–28 20–24 17–20	12–14 10–12 8–10
625–730 Sq Ft or 26′ x 26′	25′	A B C							6–7 5–6 4–5	9–11 8–9 6–8	12–14 10–12 9–10	21–24 17–21 14–17	10–12 8–10 7–8
730–940 Sq Ft or 28′ x 28′	27′	A B C							5½–6 4½–5½ 4–4½	8–9 7–8 5–7	11–12 9–11 7–9	18–20 15–18 12–15	9–10 7–9 6–7
940–1050 Sq Ft or 30′ x 30′	30′	A B C							5–5½ 4–5 3½–4	7–8 6–7 5–6	9–11 8–9 6–8	15–18 13–15 11–13	8–9 6–8 5–6

Fig. 2—Large-area, low-brightness sources placed over each board give 50 footcandles of well-diffused illumination. Systems using continuous rows of fluorescent lights are being developed with an eye to providing light of near-daylight quality throughout

severe much higher illumination over restricted areas can be added to this base. The design and installation of the combination systems must not only provide the proper direction of light, diffusion, and eye protection, but, insofar as possible, must eliminate direct and reflected glare as well as objectionable shadows.

General Lighting

The supplementary lighting, often termed "plus lighting", is usually provided by luminaires placed relatively close to the task, whereas the general lighting units are placed 8 or more feet above the work. Where supplementary lighting is employed, the general lighting serves to keep brightness contrasts between the brightly lighted work and surroundings sufficiently low to avoid eye fatigue and to eliminate shadows. It really provides a uniform base on which additional footcandles can be piled if required. To provide satisfactory seeing the additional footcandles should not be more than 10 times the base footcandles. Or, expressed another way, for every 200 footcandles of supplementary lighting there should be at least 20 footcandles of general lighting.

Broadly speaking, the aim in general lighting is to obtain a uniform level of illumination throughout the entire area. However, in locations such as boiler rooms, pipes make it practically impossible to place the outlets to insure uniform lighting. Fortunately, in such locations, uniformity is not so essential since only at certain locations are seeing tasks performed. There, adequate light of the proper quality should be provided. Throughout the rest of the area sufficient light should be available for the safety and protection of those moving about.

The evenness of the illumination provided by an overhead system is governed almost entirely by relation of the spacing between the units to their height above the floor; with semi-indirect or totally indirect equipments, such as used in offices, drafting rooms, etc, their actual hanging height is unimportant since the ceiling becomes, in effect, the source of light.

Layout of Outlets

The location of outlets determines largely how uniformly the light will be distributed over an area, just as the location of sprinkler heads regulates water coverage in case of fire. The layout of outlets will be governed by the arrangement of bays, columns, beams, and other construction details, fitting the layout as symmetrically as possible to the interior but keeping always within the limits of spacing dictated by ceiling height or height at which the units may be mounted. In general, a spacing in feet which does not substantially exceed the mounting height will result in reasonably uniform illumination.

Where mercury lamps are employed they are commonly being installed as (1) mercury lighting alone, (2) combined with filament lamps in the same unit, usually the same wattage of filament as of mercury, and (3) on alternate outlets with filament lamps.

From the standpoint of efficiency the alternate staggered combination installation is recommended. As the name implies, mercury and filament lamps are placed in alternate outlets. This is especially applicable to high bay installations, such as turbine rooms, where it is desirable to obtain maximum control and efficiency. Recommended spacing between the units is not more than 0.8 the maximum permissible spacing of an incandescent filament system. This provides good light mixture from the two systems and results in illumination approximating that of daylight in color value. This type of system is usually not recommended for mounting heights less than 13 feet, principally because of the accentuation of color shadows.

The following is a simplified method of determining outlet spacing, lamp size and mounting height for both low and high bay lighting installations. These calculated values are for various lamp sizes, various lamp types (filament, mercury and fluorescent) and various equipment types.

Here's the Plan

Step 1—Sketch the floor plan of the room to be lighted and arrange outlet spacing symmetrically with respect to bays or columns. Table I gives the usual spacing as well as the maximum allowable spacing for various ceiling heights, assuming the units are mounted as high as possible. Determine actual area per outlet and apply the result in Table III.

Step 2—Classify the room and maintenance conditions into one of three classes in Table II. This takes into account proportions of the room, interior finish, and maintenance conditions, each of which bear an important relation to the lighting results. Apply this "conditions factor" in turn in Table III.

Table IV gives illumination levels calculated for continuous rows of 40-watt daylight fluorescent lamps equipped with 2-lamp vitreous-porcelain-enameled steel reflectors, each reflector having two lamps.

The control panel with its various meters, switches, etc, requires special lighting to be easily visible (Fig. 1). Such lighting may be provided by a directional source so located that its image is not reflected by instrument glasses or by a large-area relatively low-brightness source such as described in April POWER.

A study made by the committee of

TABLE IV—CALCULATED ILLUMINATION LEVELS†

(Two lamps per reflector)

Area per reflector or spacing between rows	*Minimum distance from underside of reflector to floor*	*Conditions factor*	*Average footcandles**
21.6 sq ft or 5 ft spacing	7 ft 6 in.	A	62–74
		B	50–62
		C	37–50
26 sq ft or 6 ft spacing	7 ft 6 in.	A	51–62
		B	41–51
		C	31–41
30.4 sq ft or 7 ft spacing	7 ft 6 in.	A	44–53
		B	35–44
		C	26–35
34.6 sq ft or 8 ft spacing	8 ft	A	39–46
		B	31–39
		C	23–31
39 sq ft or 9 ft spacing	8 ft 6 in.	A	34–41
		B	27–34
		C	20–27
43.3 sq ft or 10 ft spacing	9 ft 6 in.	A	31–37
		B	25–31
		C	18–25

** These values are computed for the daylight lamp. To obtain values for the white lamp add 25% to the above figures.*

† For continuous rows of 40-watt daylight fluorescent lamps equipped with 2-lamp vitreous-porcelain-enameled steel reflectors.

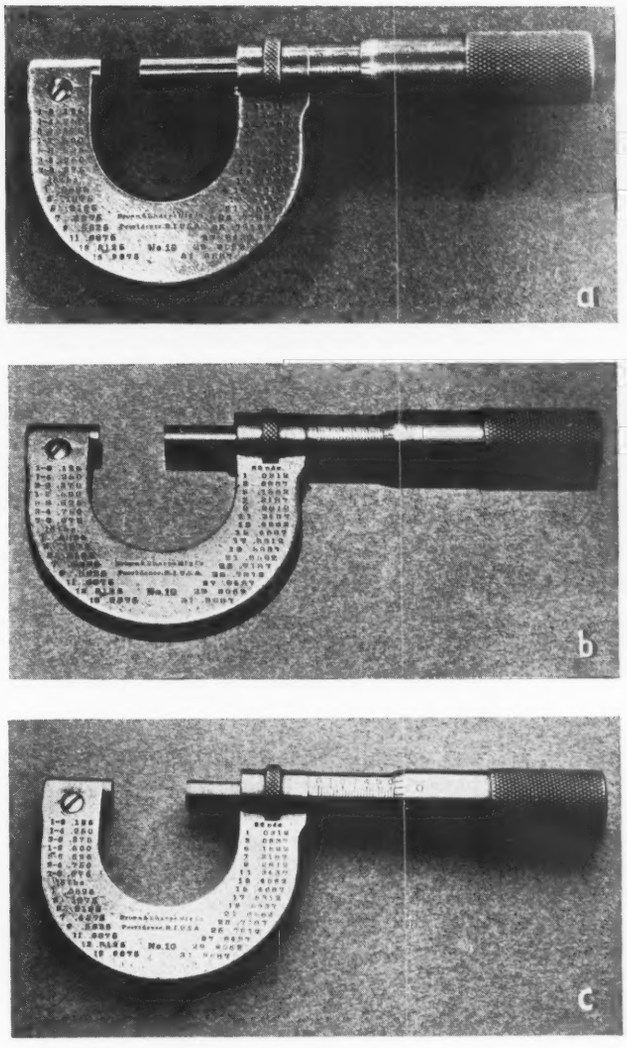


Fig. 3 — (a) Micrometer under general lighting system. (b) Reflected glare, the result of concentrated light, makes numbers on barrel hard to see. (c) Large-area, low-brightness source gives high visibility.

the Illuminating Engineering Society revealed that *quality of lighting* was the most important factor in obtaining good visibility of typical difficult seeing tasks performed. The micrometer caliper was selected for experimental work because of its universal use, its portability, and its similarity to the majority of seeing tasks encountered. From the micrometer illustrations shown, Fig. 3, it is evident that the best visibility is obtained when a source of large area and low brightness is employed. The reflection of such a source is a band of sufficient width to form a uniformly bright background for the figures and divisions which must be seen. High visibility was obtained because of the good contrast between the dark figures and the bright background.

Engineer's Office

In the engineer's office lighting should be primarily designed to provide at least 30 footcandles to meet visual requirements. Lighting equipment of the indirect and semi-indirect types are recommended. This requires that the ceiling be finished with a white or light cream-colored paint to provide good reflection. The ceiling should, of course, have a mat finish to avoid bright reflections. If it is extremely difficult to keep clean, direct lighting such as is obtained from Glassteel Diffusers, or semi-direct, such as produced by enclosing globes, is often more practical than indirect lighting. Where an enclosing globe is used, the unit should be of large diameter and equipped with a parchment shade in order that glare will be minimized and diffusion will be reasonably good.

The accepted level of illumination for drafting rooms has been rapidly increasing during the past years due to the realization of the constant eyestrain that is imposed upon the draftsman as he works on a fine detailed drawing throughout the day. Today the recommended level is 30 to 50 footcandles and higher values than these are being provided.

Perhaps the most common error in drafting-room lighting is in the type of unit used. In quite a few instances enclosing globes have been used and the lighting result has been unsatisfactory. The reason for this is due to the high brightness of the units which causes uncomfortable glare and poor diffusion with bothersome shadows. Sharp or dense shadows are extremely annoying in the drafting room, especially those cast by the edge of a T-square or triangle or by the hands of the draftsman.

Two methods are generally being employed today in lighting drafting rooms. One is to provide a good mat-white ceiling and to use totally indirect lighting; the other is to employ a large-area source of low-brightness over each board (Fig. 2). With either system reflected glare is negligible and shadows are soft and luminous.

Keep It Clean

No matter how carefully designed a lighting system may be with respect to type and size of lamp and reflector, spacing of outlets, etc, it must be kept clean if it is to remain in good operating condition.

Dust and dirt allowed to accumulate on reflecting surfaces of lighting equipment may, in a month's time, decrease the light output 20 to 25%. Make an illumination check with a light meter, (See page 73, April POWER). In this way adequate cleaning schedules may be determined. In addition to cleaning units, frequent painting and maintenance of the surroundings—side walls, ceilings, machinery, etc—will help keep the lighting efficiency near the original value.

Why Not a Coking Index?

From long experience, C E Pritchard, combustion engineer, feels that the nature of the coke formed fixes to a large extent the suitability of a coal. He shows how using a "coking index" helps solve practical coal-selection problems and suggests development of a standard "indexing" method

▶ POWER AND FUEL ENGINEERS agree that comparison of coals involves more than price and heating value; if that were all, coal selection would be a simple matter. There is less agreement as to just what qualities are most important and how they should be evaluated.

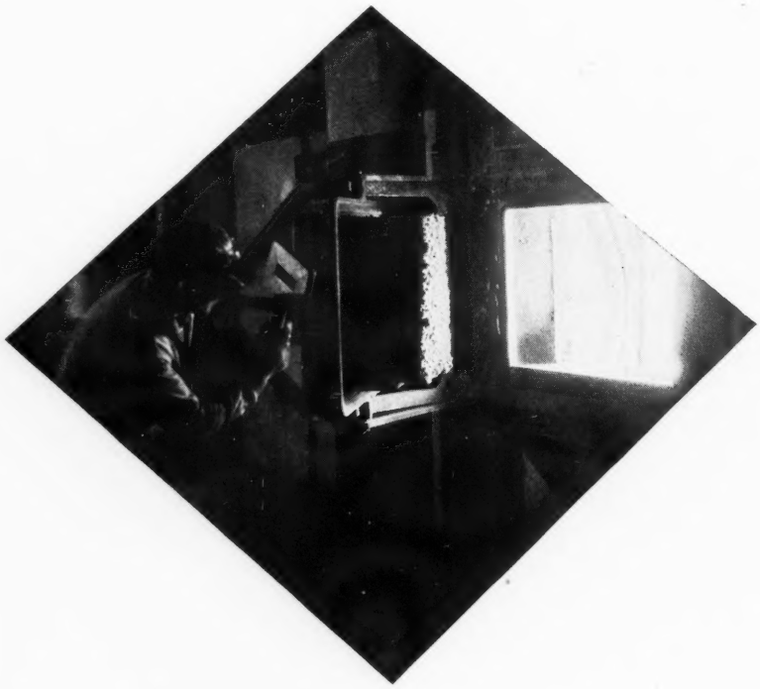
For a given furnace and firing equipment, it is possible to estimate, or to determine by experience, certain broad limits for the volatile and ash content and for the ash-fusion temperature. This gives a range of coals that *can* be burned with reasonable satisfaction; choice between them boils down to some form of plant testing.

It might seem reasonable that evaporation results would closely follow differences in heating value, but a little testing experience shows that other factors affect actual results on the fuel bed. Identifying these other factors and working out some way of measuring them and predicting their effect in advance will explain many apparent discrepancies in evaporation test results and allow coal selection, in many cases, without prolonged evaporation testing.

Coke Structure

My experience shows that coke structure is one of the most important of these factors, and a rough method of evaluating this factor, using a so-called *P* index, has helped solve many coal-selection problems. Before going into greater detail on the coking index and its application, let us see why the coking characteristics should be so important.

Bituminous coal, as mined, is a raw material. The first part of the job done by every fuel bed is to turn this raw material into a manufactured fuel—coke, virtually pure carbon. Thus, on a typical fuel bed, we deal with coal only about 5% of the time between entrance and ash; the rest of the time we burn coke. Successful combustion depends on the condition of this coke; the nature and size of the particles must be such as to permit close contact between fuel and air. The stoker operator learns to spot the difference between an open bed of coke, well aerated and burning freely, and the other extreme, a heavily sintered bed. What we want to know is what makes the difference.



Two basic factors determine the nature of the coke: the temperature and motion of the fuel bed, and the coking characteristics of the coal itself. The first depends on firing equipment to some extent, but even more on the kind of loads carried. Hand-fired fuel beds have little or no motion beyond that imparted by the fireman's rake or a rocking-grate section. Different stoker types impart varying amounts of motion or agitation.

At peak loads, temperatures in the fuel bed run high, and since motion depends largely on rate of fuel feeding, there is usually ample agitation to keep the coke broken up and well aerated. At low loads, both temperature and motion drop, permitting the coke to build up and set. When load picks up again, the heavy coke formations resist the breaking action of the increased motion.

To get best fuel-bed performance, we should match load characteristics against the coal's coking characteristics. Roughly speaking, a strongly coking coal will serve for heavy, steady loads, but a weakly coking coal will work best on fluctuating loads. Likewise, for handfiring, we need a weak coke, but on a stoker with good agitation we can handle a strong coke.

So much for needed coking characteristics. How can we determine and measure them in actual coals? We know that the amount of pyridine, an organic oil, present in the coal determines, to a large extent, the density and strength of the coke formed. Thus, it seemed logical to call coking ratings a *P* index. First use of a coking index came about in this way: In 1925 a large industrial plant in the Mid-Hudson area sought better coal for its multiple-retort underfeed stokers. These units were old, and had a limited grate area for prevailing loads, about 185% of normal. Ash-pit losses were high.

Before ordering test shipments, I accumulated about 70 samples of representative coals and arranged to test

their flash or agglutinization temperatures in order to measure early brilliance in the furnace. These flash values ranged between 600 and 1100 F. Specific gravity and total mass of the corresponding coke structures varied in the same order, with light cokes corresponding to low flash temperatures and coke density increasing as the flash point rose.

The coal finally selected (Buffalo and Susquehanna's Sykesville Mine) showed exceptionally fast ignition, low flash point, and weak coke structure. Competitive coals with higher flash points and stronger coke structures gave higher ash-pit losses and lower evaporation results, even though all were good commercial steam coals and price adjustments were allowed for variations in heating value.

The management, not wanting to be tied to one source, sought another equally satisfactory fuel. Using geography as a guide and working from known proximate analyses, we tried coal from the Helvetia Mine. It had everything in thermal value the Sykesville coal had, with a few heat units to spare, but it failed to come with $0.50 per ton in steam value. Careful study of the fires and analysis of the coke structure pointed to a difference in the coking quality as the answer.

Collecting Data

This experience led to collection of data on coke structure. Comparison as to density and strength of cokes formed in porcelain crucibles yielded much information, as did density measurements and shatter tests of cokes taken from actual firebeds. Additional valuable data developed from watching incandescent coke in action under varying load conditions. It soon appeared that there was a definite relation between coke strength and density and the behavior of the coke under different conditions.

From this data came a series of coke ratings, called *P* numbers, with an arbitrary scale of seven grades from 0 to 6. Thus a *P* index of 0 indicates the weakest coke structure while a rating of *P* 6 marks the strongest and densest coke. Using this rating scale, representative eastern coals have been classified by seam, Table I. Note that index values for a few representative coals from a given basin do not constitute a criterion for coke structures in the entire field. Light cover and weak roofs in a mine may have permitted active coking oils to leach out over the centuries, reducing the coking index. Likewise, the index drops from two to three points from deep-cover coal to the crop of the same mine.

A clearer picture of the meaning and usefulness of this coking index can be obtained by considering a few actual applications. Take, for example, two coals from the Pittsburgh seam of the Connellsville Basin with little or no difference in analysis:

	1	*2*
Volatiles	28.69	30.60
Fixed Carbon ...	63.89	62.25
Ash	7.42	7.15
Heating Value ..	14,180	14,220
Fusion Temp.	2870 F	2900 F
P index	6	4

These coals, fired on a Combustion Type E stoker, had to meet a dyehouse load fluctuating from a base of about normal boiler rating to a peak of about 200% above normal. The No. 1 coal showed a creeping pancake clinker and fires had to be cleaned every two hours. The No. 2 coal produced little clinker and fires were cleaned every four hours. With No. 1 coal, when steam demand dropped the temperature decrease apparently permitted the coke to set at the density characteristics of its *P*-6 rating. Then, as fuel-bed motion increased on the next call for steam, the heavy coke formed a reflecting cover over the ash so that the deep heat could not be released and bore heavily against the ash layer. The *P*-4 coal formed a less dense coke, which broke up with the motion, releasing heat and getting full aeration.

In tests at a college heating plant, a Jamison No. 2 pea stoker coal with a coking index of 3 showed up better than a Burgoo coal running consistently superior in analysis. Here the difference could be seen in the fires before coke tests were made or steam results were known. With ratings 25–40% above normal, the Jamison coal broke down under heat and motion while the Burgoo showed torch tongues and spotty illumination.

We fished out a piece of Burgoo coke, quenched it, and sawed out a 1-in. cube. On this we dropped a 10-lb weight from a height of 2 ft. Of the resulting particles, 8% passed through a ¼-in. square-mesh screen, which corresponded to a crucible coke index of 5. Using the same procedure, 12% of the Jamison passed through the screen, corresponding to its index of 3. The steam figures later showed an advantage of $0.61 per ton in favor of the Jamison, apparently due to its more suitable coking qualities.

Using the Index

My own experience with these particular index values indicates that a low index (0 to 1.5) is needed for satisfactory handfiring and that values under 2 give best results on small domestic, commercial, and industrial stokers. Natural-draft overfeed stokers do best on coals of medium *P* index (3 or 4); if the coke is too weak, excessive ash-pit loss results. For the larger single-retort underfeed units, the *P* index depends on load characteristics but shouldn't run over 4. Multiple-retort underfeed stokers will handle the widest range of fuels, but careful matching of *P* index against load will produce better results.

The examples cited show the usefulness of a coking index in coal selection. This characteristic does not supplant others, but its importance in explaining evaporation-test results and predicting coal performance under actual load conditions cannot be overestimated.

The method of classification sketched here does not represent a scientific procedure; it was evolved over a period of years to meet practical needs. To put coking values in their proper place as an aid in coal selection requires a standardized, scientific measuring method, preferably simple, to which research organizations, producers, and consumers could agree. With a standard method, coking values for representative coals could be published much as proximate and ultimate analysis data is today, producers could give coke values as part of a typical or guaranteed analysis, and consumers with the proper facilities could check coke values for themselves.

Table I—Coking-Index Ratings for Typical Eastern Coals

Seam	*Field*	*Index*
Lower Kittanning	(Nanty-glo)	0 to 1.5
Lower Kittanning	(S Fork & Windber)	1.5 to 2.5
Lower Kittanning	(Clearfield)	2 to 3
Lower Kittanning	(Reynoldsville)	2
Upper Kittanning	(Windber)	1
Upper Kittanning	(Reynoldsville)	2
Lower Freeport	(Cambria)	3
Lower Freeport	(Reynoldsville)	3
Upper Freeport	(Reynoldsville)	3.5
"E" Seam	(Cambria)	2
"D" Seam	(Clearfield)	4
Moshannon	(Clearfield)	2
Sewickly	(General)	1.5
Sewell		3
Pocohantas		4 to 6
New River		3.5
Fulton	(Bedford)	4.5
Barnett	(Bedford)	3

Timed Lubrication

In April* POWER, *James I Clower, well-known author on lubrication and associate professor at Virginia Polytechnic Institute, described force-feed units and their applications. This month, he extends their use to timed lubrication of engines and other equipment

▶ It is now generally recognized that more satisfactory lubrication of the cylinders of large gas, oil, and diesel engines is obtained by delivering the oil by force-feed lubricators directly onto the pistons, between the rings, at a definite point of the stroke. Doing the job this way is called timed lubrication.

Diesel Engines

Timed lubrication is particularly advantageous on engines in which the oil holes are uncovered at some point of the stroke. If the oil enters at a time when the oil ports are uncovered, most of it would be wasted. If delivered above the rings, the oil is likely to be burned, thus not only being wasted but also adding to the formation of carbon deposit. Oil supplied to the piston skirt is of little value, as most of it is wiped off by the oil-scraper rings. In either case, very little oil reaches the top rings where it is most needed.

On 4-stroke-cycle engines, best results are usually obtained by injecting the lubricating oil onto the piston between the first and second rings when the piston is at the end of the power stroke. The piston then makes two strokes with very little pressure behind the rings and one stroke under pressure before combustion occurs, and effectively spreads the oil over the cylinder-wall surface.

2-Stroke Cycle

In 2-stroke-cycle engines, in which every other stroke is a power stroke, most efficient lubrication is obtained by injecting the oil onto the piston, at the beginning of the compression stroke, at a point just above the exhaust ports. Injections at this point eliminate the possibility of the oil being wiped out through the exhaust ports before it can be distributed over the cylinder wall.

For timed lubrication it is necessary to synchronize the eccentrics of the lubricator with the pistons of the engine. Fig. 2 shows the eccentrics of a 4-feed lubricator synchronized to deliver oil to each piston at the end of each power stroke of a 4-stroke-cycle, 4-cylinder engine. The lubricator is driven from the cam shaft of the engine, which turns at half engine speed, firing order of the engine being 1, 3, 4, 2.

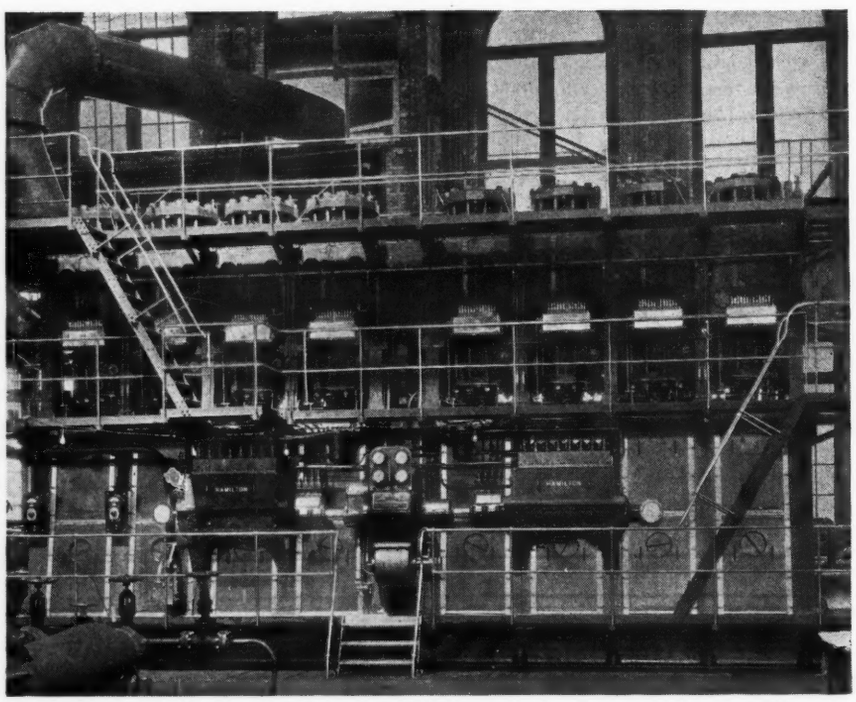


Fig. 1—Eight 12-feed, force-feed lubricators on an 8-cylinder, 7000-hp diesel engine

The eccentrics of the lubricator are set 90 deg apart, but arranged according to the firing order of the engine, at 0, 90, 270, and 180 deg. No. 1 piston is shown at the end of its power stroke and the lubricator eccentric in full discharge position, the oil being delivered at this time directly onto the piston between the first and second rings. Piston No. 2 is at the end of the exhaust stroke, No. 3 is at the end of the compression stroke, No. 4 is at the end of the intake stroke.

For timed lubrication it is necessary that design of the lubricator be such that the eccentrics can be adjusted on the eccentric shaft. Special force-feed lubricators having adjustable eccentrics are available for timed lubrication.

Applications

Timed lubricators find wide application. They are used for timing delivery of oil to cylinders of uniflow steam engines, roller bearings of endless chains, and other moving surfaces. Fig. 1 shows eight 12-feed lubricators on a 7000-hp diesel engine. Each lubricator feeds oil to 10 points on a cylinder. Feeds 1 to 6, from the drive end of the lubricator, deliver oil on the upstroke 40 deg before the piston reaches top dead center. Feeds 7 to 10 deliver oil to the cylinder on the downstroke 35 deg before the piston reaches bottom dead center. Feeds 11 and 12 are connected to the piston rod and deliver oil simultaneously with Feeds 7 to 10.

A satisfactory terminal check valve

is necessary for proper operation of any force-feed lubricator. In pressure lines, the terminal check valve prevents line pressure from backing into the lubricator, and in vacuum lines the spring is sufficiently strong to hold the ball valve on its seat and thus prevent the vacuum from drawing oil out of the lubricator. Check valves also insure immediate delivery of oil at the first stroke of the pump plunger, as they prevent oil from draining back into the lubricator during periods of shut-down.

Check Valves

Figs. 3 and 4 show three typical designs of check valves. Fig. 3 is a double-ball, spring-loaded valve and Fig. 4 two single-ball, spring-loaded valves. A check valve especially designed for timed lubrication is shown in Fig. 5. Correct location of check valves in the oil-feed lines of a steam engine is just outside the steam-pipe connection.

Dirt, the worst enemy of lubricators, will gradually accumulate in the reservoir and pump units. Hence, it is necessary to clean periodically all force-feed lubricators. Frequency of cleaning will of course depend on local conditions. When cleaning, scrape the dirt out of the reservoir and flush with gasoline or

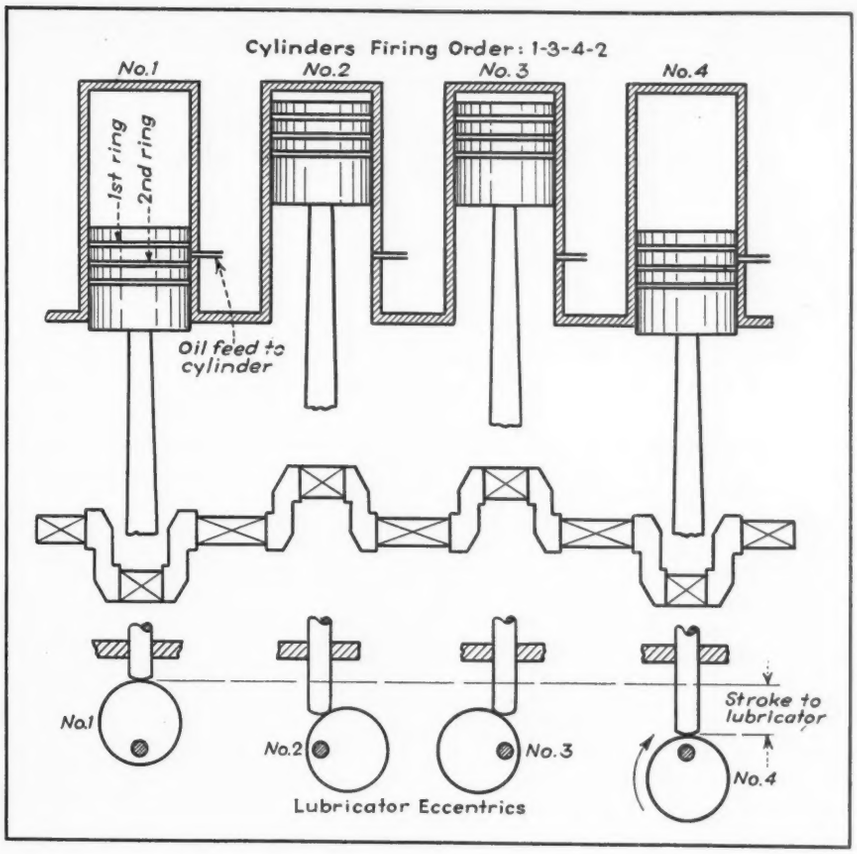


Fig. 2—Timed lubrication of a 4-cylinder, 4-stroke-cycle internal-combustion engine

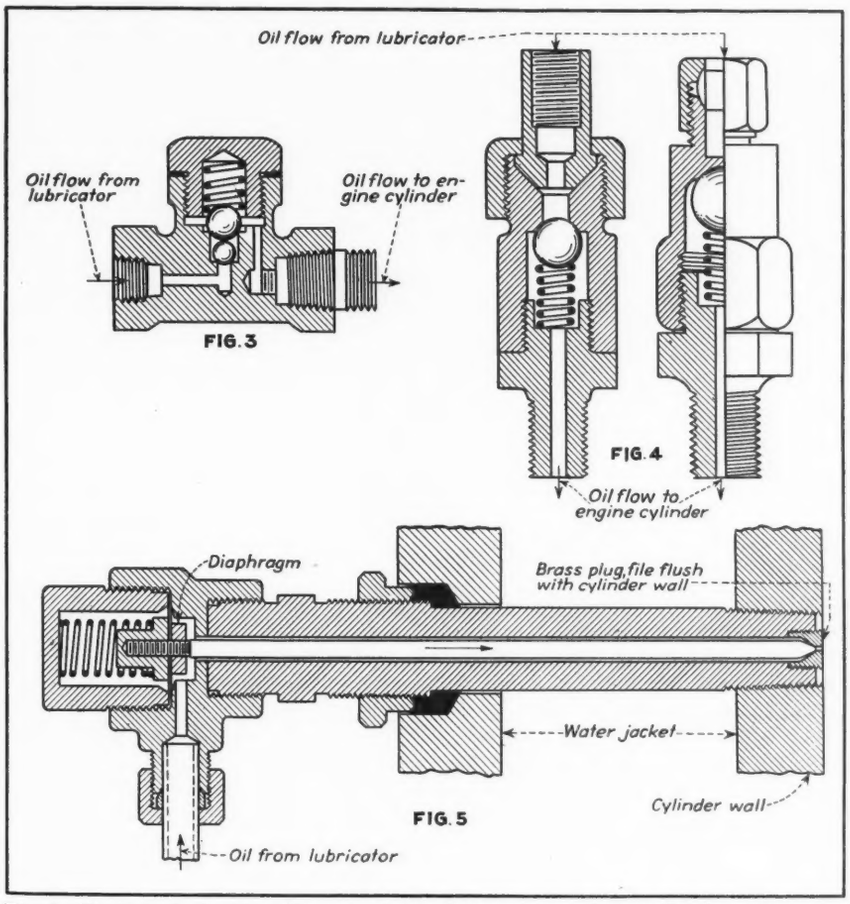


Fig. 3—Horizontal, double-ball, spring-loaded check valve. Fig. 4—Single-ball, spring-loaded check valves. Fig. 5—Diaphragm-type check valve for timed lubrication

kerosene. Before pump units are replaced in the reservoir, submerge them, one at a time, in gasoline or kerosene. Hold them in a vertical position and operate by hand. After lubricator has been reassembled, operate each pump unit by hand until all gasoline or kerosene is pumped out, then connect to feed lines.

When mounting lubricators make sure they are rigidly supported. Drive rods must be straight to prevent binding at pin joints.

Force-Feed Unit

The force-feed lubricator works automatically, starting and stopping with the machine it lubricates; it is positive, dependable, and delivers a measured amount of oil independently of temperature and pressure variations. When first introduced in 1898, it was used for supplying oil to cylinders only, but today its many advantages over less-reliable methods of lubrication are recognized and it is being applied to virtually all classes of machinery. In recent years, motor-driven units have found wide application to machine tools, presses, paper and rubber-mill machinery, steel-mill equipment, glass-making machines, printing presses, and countless other machines and equipment.

Speaking of Power

Utica, N. Y., was explored back in February. Not that there's wild and wooly country up that way, nor are there heathen tribes waiting for salvation. What actually took place was a fact-finding expedition conducted by Associate Editor "By" Sawyer, who spent two days in Utica chasing subscribers and asking them what they didn't like about POWER, how we are treating them, what they

Exploring Utica

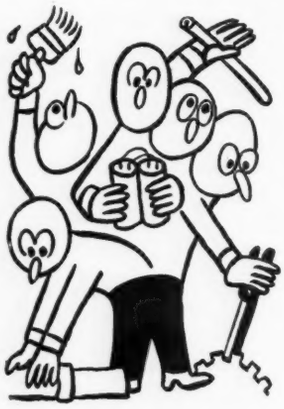
would like to see more of, etc. . . . As many of you know by now, we have, for the past four years, been asking by mail about 120 subscribers each month how they like the current issue. In this way, we try to find out the kind of an editorial job power engineers want, the kind of a job most useful to them.

But letters, no matter how well written and how scientific the sampling, have the disadvantage that they may be answered only by the people who like to reply to letters. Thus, you can never be definitely certain that Mr Farley's mail service will bring you back an expression of the majority opinion. The only way to find out is to go out and ask people. . . We plan to have one of the editors put on his hat two or three times a year and go on a safari with the definite purpose in mind of interviewing POWER subscribers. This, added to the

Straight and narrow path

information we gather from readers on our numerous regular editorial trips, will keep us on the straight and narrow path of practical service.

One of the highlights of the Utica trip was the half day spent at Harbor Point Station of Central New York Power Corp, manned by an able, energetic gang deriving real pleasure from operating a smartly run plant. Although normally a standby station, Harbor Point had been on the line 24 hours a day for the previous three weeks, turning out full capacity of two 15,000-kw machines. Four



A jack of all trades

boilers generate steam at 275 lb, 580 F. . . . Another highlight was an hour's chat with John Miller, chief engineer of Broadacres Sanitarium — a jack of all trades. Besides currying and feeding three 1500-sq-ft heating boilers, he mans the pumps, puts in sewer pipe, keeps up all wiring and electrical equipment (which includes nursing X-ray lamps), and maintains several buildings in reputable repair. . . . Miller solves the problem of scale in his hot-water tanks by painting them inside with asphaltum. Now he gets no scale, but has to repaint once a year, as the asphaltum "cheeses up."

By the time this issue is off the press, I hope to be hitting the highways of North Carolina — land of pine trees, mountains, textile plants, tobacco factories, and a population that combines the virtues of the go-getting North and the hospitable South. . . . Aside from a few speaking

Swapping ideas

engagements, I have no cut-and-dried schedule. I just want to keep bowling along from one smoke stack to the next, stopping off to swap ideas with engineers. As usual on such runs, I shall carry typewriter and camera to record any gleanings of interesting ideas.

Keep an eye open for the 16-page internal-combustion-engine section in June. This will tabulate about 400 diesel and about 100 gas-engine installations put into operation between April 1 last year and April 1, 1940. . . . In addition, this section will carry about a dozen short plant descriptions, each summing up the essential facts about a typical modern installation. The plants described will be selected to give variety in size and type of service.

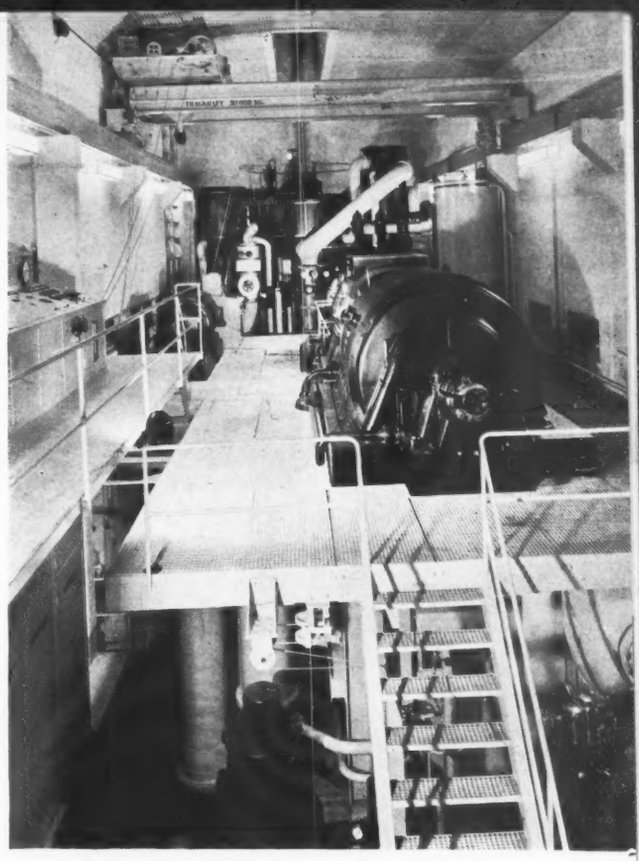
At the risk of having this issue of POWER labelled "the Disney number" (see article on new air-conditioning job, page 74), I am prompted by Pinocchio to say more about the man. Disney's presentation of this child's story strikes me as a masterpiece. Beyond question, he is a genius. But that is not all; having talked with him, I know he is a most modest individual. No stuffed shirt there—

Understands his men's jobs

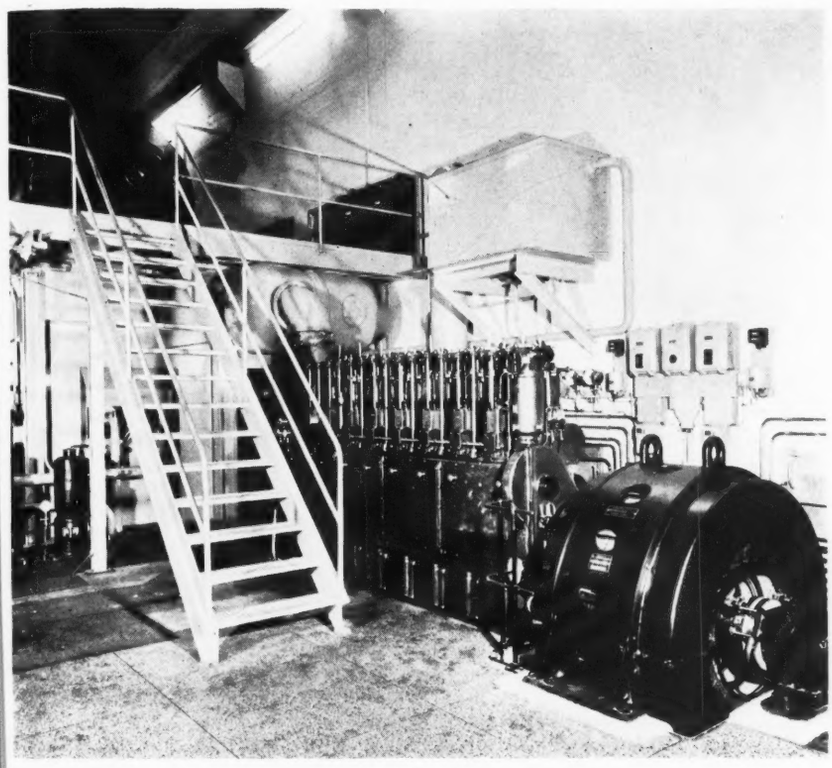
nothing but ability and performance. . . . All of which gives me another chance to philosophize. Some business men claim that it isn't necessary for an executive to understand the details of the work his men are doing. That wouldn't work with a major film cartoon, would it? . . . A Disney film could not be produced by one man, because of the enormous number of pictures to be made. Its production requires organization and executive ability. Disney is that executive. Yet, I am sure that if he were not also an artist, he could not direct other men in producing films of such quality.—*P W S*

Tough Nut to Crack

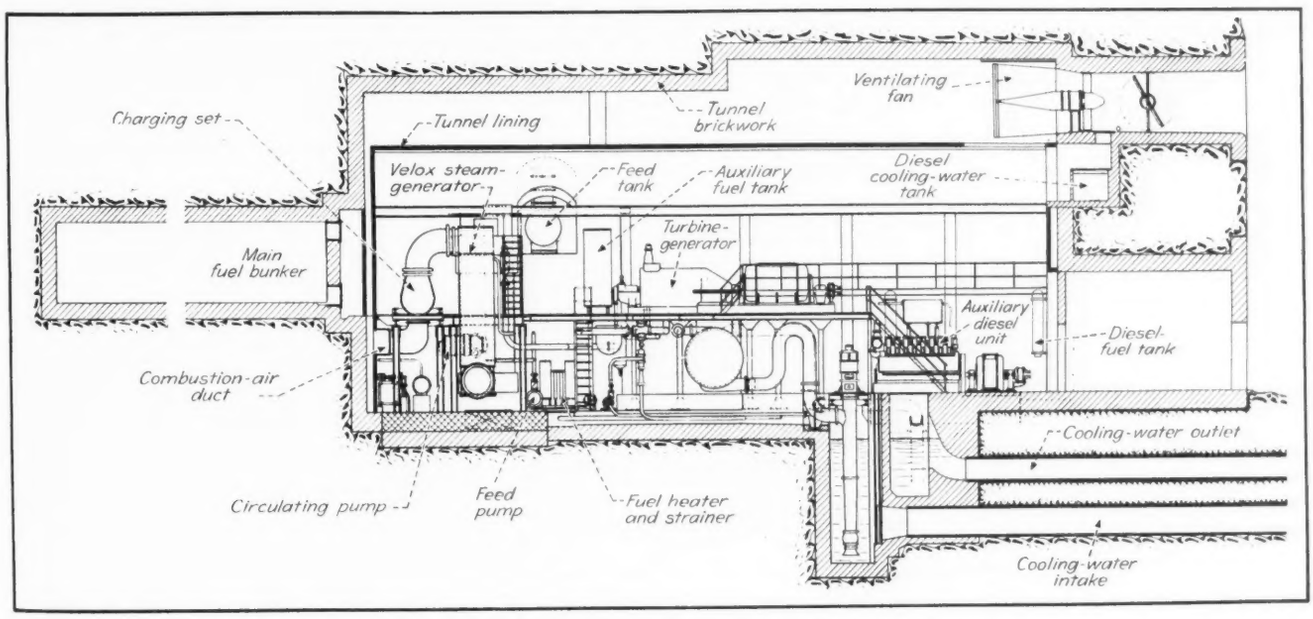
▶ SWITZERLAND IS A NEUTRAL but believes in preparedness. Before hostilities broke out, her engineers were scheming protective arrangements for the power supply of important cities and designing power plants that would stand up under bombing. Such plants must first of all be tough nuts to crack, but besides they must cost as little as possible to keep down expenses while the plant stands idle waiting for the alarm. The 9000-kw plant at Berne shows one solution.



A tunnel in the mountainside houses a 100,000-lb-per-hr, 360-lb, 780-F Velox boiler, a Brown Boveri single-cylinder impulse-reaction turbine-generator and all necessary auxiliaries, including a 400-kw starting diesel. Fitted into a space about 80 ft long and 30 ft high, this extremely compact plant occupies about one-third as much space as a conventional one



This diesel set, pushbutton started, provides current for auxiliary motors if the system supply is interrupted. Combining a quick-starting forced-circulation boiler and a turbine designed for a short warm-up period permits bringing the station up to load in less than 15 minutes. To avoid complication and keep down cost, the station was not made fully automatic; the normal operating crew consists of an engineer and helper



The sectional view shows concrete-lined shafts to and from the river, for circulating and diesel-cooling water; the rock-protected fuel bunkers; and the ventilating system. An axial fan delivers air to the space between the tunnel wall and the plant walls from which it enters the room through adjustable dampers. The combustion-air fan draws from the space between tunnel wall and inner lining, also. Air outlet shaft houses boiler, diesel, turbine safety-valve exhausts, and general safety-valve piping

"LET'S TELL EVERYBODY

how we made our old home look like new!"

with

Its Right MASONITE TRADE MARK REG. U. S. PAT. OFF.

MASONITE

PRESDWOOD

TEMPRTILE

THE WONDER WOOD OF A THOUSAND USES • SOLD BY LUMBER DEALERS EVERYWHERE

Its Right MASONITE TRADE MARK REG. U. S. PAT. OFF.

MASONITE recently joined the host of outstanding industrial and central station companies who have swung to RILEY BOILER AND FUEL BURNING EQUIPMENT. RILEY'S rapid rise to a position of leadership in the boiler industry is due to the fact that results from RILEY installations repeatedly exceed guarantees and surpass formerly accepted standards of performance.

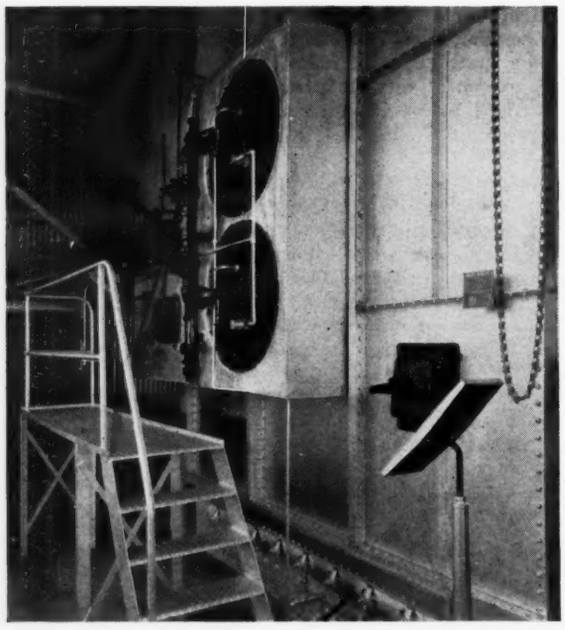
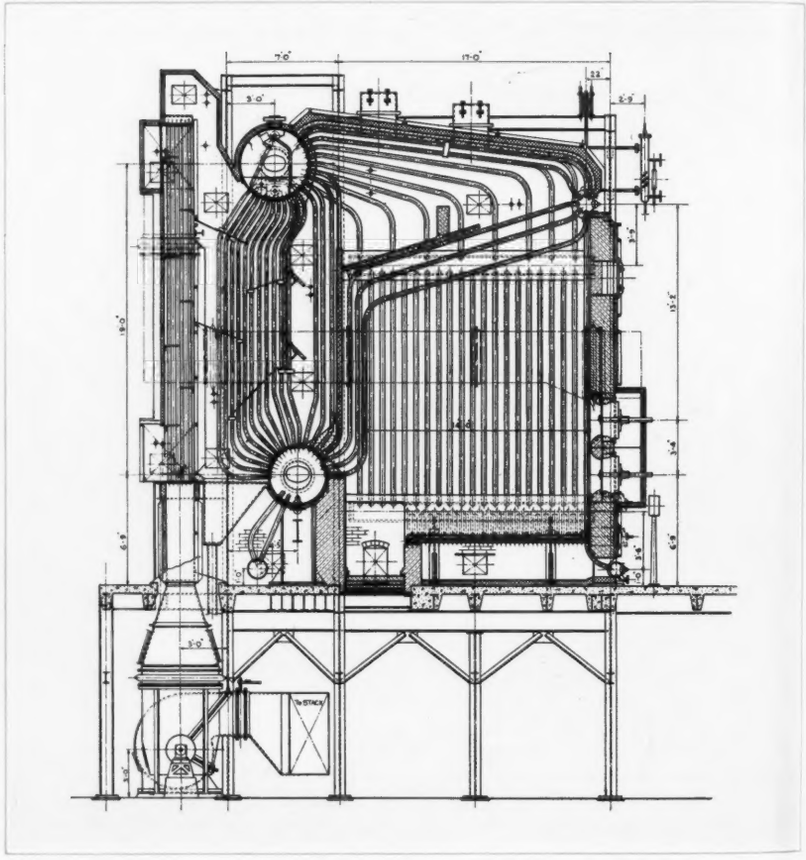


Photo of front of Riley unit showing gas burners. Note excellent appearance of gas and air tight steel-clad insulated casing.



RILEY GAS-FIRED BOILER UNIT
MASONITE CORPORATION, Laurel, Miss.

This unit operates at 70,000 pounds of steam continuously with peak loads of 75,000 pounds though guaranteed maximum continuous capacity was only 50,000 pounds per hour. Plus value characteristics of Riley Boiler equipment.

TRADE MARK Rx REGISTERED

RILEY

STOKER CORPORATION, WORCESTER, MASS.

Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Tacoma Baltimore Milwaukee Denver
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It will pay you to visit modern Riley Installations

—you have good reasons to do so MASONITE

. . . likewise LET'S TELL EVERYBODY about the new RILEY BOILER UNIT you recently installed.

Yes, Masonite, you have good reasons for telling everybody how they can make their old home look like new with Masonite PRESDWOOD and TEMPRTILE and, likewise, Riley has equally good reasons to tell everybody about the savings in steam costs which they can make by installing Riley steam generating units.

So let's start off by telling them about the Riley Unit you recently installed at your Laurel, Miss. plant.

June 28, 1939, Masonite Corporation placed their order for a 60,000-pound per hour, 450-pound pressure, Riley Unit consisting of Riley Boiler, water-cooled furnace, air heater and steel-clad insulated setting, fired by natural gas. On September 23, a drying out fire was placed in the unit and, on October 2, the unit was placed on the line and stayed there. In other words, in just 96 days from the date of the order the unit was in regular operation, giving satisfactory service, which is fairly fast work.

Now let's see about performance. At 50,000 pounds of steam per hour, the air heater exit gas temperature was guaranteed not to exceed 395 degrees. In actual operation at 54,500 pounds of steam per hour the air heater exit gas temperature was only 377.6 degrees. The temperature of air from the air heater was actually 374 degrees, though the guarantee was only 338 degrees. Such performance means considerably higher efficiency than the guaranteed efficiency of 81.5% when burning natural gas. The maximum guaranteed capacity of the unit was 50,000 pounds continuous and 60,000-pound 15-minute peaks. Quoting from letter from Mr. E. G. Grady, plant engineer—"For the past 75 days the average hourly load on the new boiler has been 70,000 pounds with peaks of one and more hours duration of 75,000 pounds." The ability of the Riley Boiler to operate at this excess over guaranteed capacity "Means a net saving of 10,000 pounds per hour of 200 pound pressure steam." Another example of the plus values characteristic of Riley installations.

Photo of side of unit showing forced draft fan and instrument board. Note rugged construction of casing and positive metal to metal air tight seals at water wall header.

But Mr. Grady, since you have told us what you think of Riley and Riley equipment, we will use your own words to tell everybody what they can expect from Riley.

"Right here we would like to go on record and congratulate you and your organization on the way the whole job was handled, and this means from the date of sale until the time the unit was put in operation, giving particular credit to your erector, who is the best man on this work we have ever seen or heard of."

Thanks, Mr. Grady, for helping us tell everybody that they can rely on Riley.

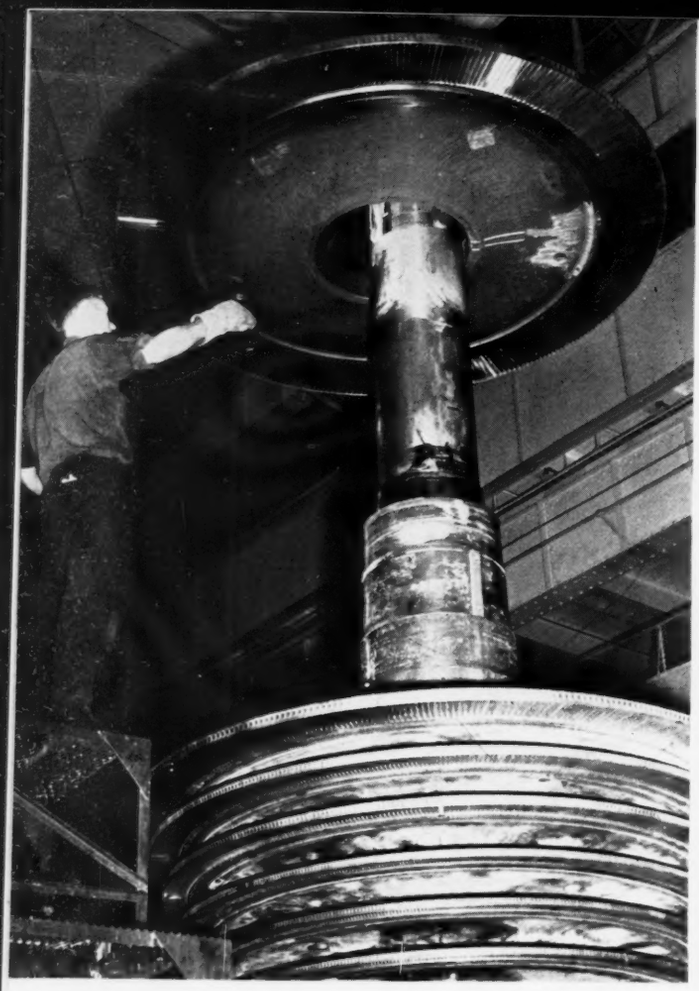
If you are considering new boiler or fuel burning equipment visit a Riley installation and check its performance. There is nothing we like better, since such investigations definitely establish the superiority and greater value of Riley equipment.

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs

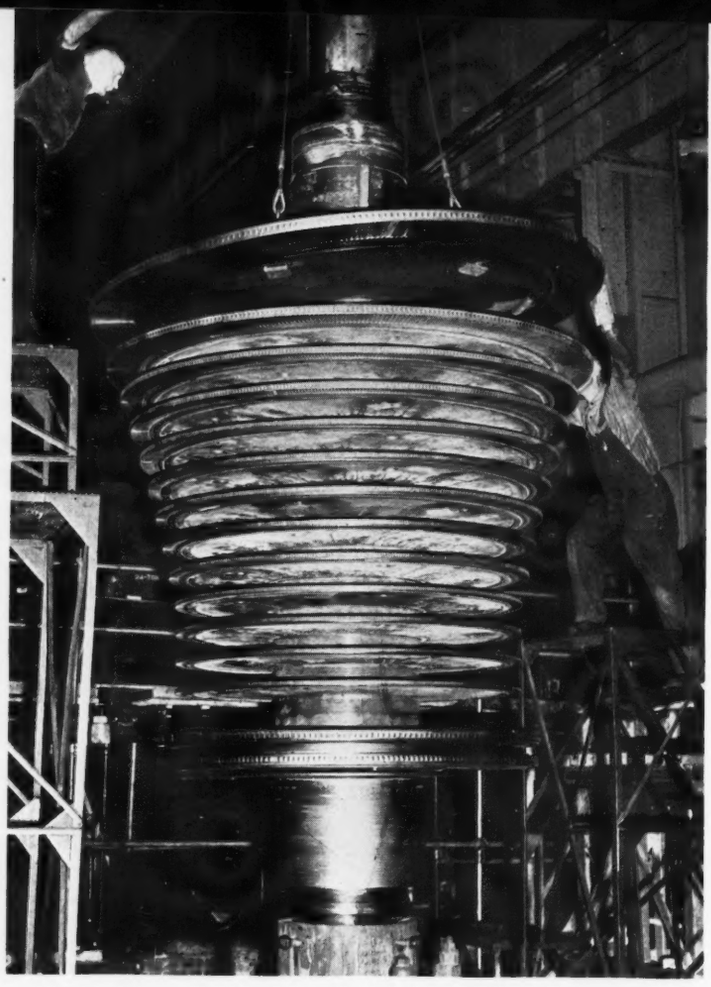
COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS • AIR HEATERS
ECONOMIZERS • WATER-COOLED FURNACES • STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

before purchasing Boiler or Fuel Burning Equipment



Wheel disk, heated to about 350 F in a furnace, is gently but rapidly lowered over the shaft, which is held upright



Wheel must be located truly on the shaft within close limits. Everybody works together against time as the wheel will freeze if there is delay

They Shrink to Fit

▶ TURBINE WHEELS have to be fastened to the shaft pretty close to where the designer figured they should be, and they are supposed to stay put. The wheels of this 50,000-kw General Electric turbine average 3000 kw at full load and must be able to take a safe margin of stress and vibration. Turbines depend on shop skill as well as the research laboratory so that the buckets can travel millions of miles, with only a few thousandths of an inch clearance.

After the wheel is cooled by water, the shrink fit assures permanent tightness

THE OPERATING ENGINEER

George Edwards
Advisory Editor

Practical Aids
Maintenance Hints
Questions — Answers

Published monthly as an integral part of POWER

So It's MAINTENANCE *You Want*

At the Empire State Bldg, world's tallest building, they have a maintenance set-up for elevators that can well serve as a model for any kind of power equipment. F G Rechberger, elevator engineer, shows how job is done to get best service at lowest cost

Fig. 1—A locked glass-front cabinet in each motor room contains three fuses of each size used on the system

GOOD ELEVATOR SERVICE goes a long way towards keeping tenants satisfied. In the Empire State Building, New York, N. Y., we believe that careful inspection and maintenance is the backbone of good elevator service. No matter how efficient and courteous the starter and operators may be, their efforts are largely lost unless the elevators are reliable.

With these facts in mind, we have given a great deal of study to our elevators and have developed a system of regular inspection and maintenance that makes their service reliability practically 100%. We have also worked out a communication system so that elevator mechanics can be reached immediately in case they are wanted.

The basis of this work is a carefully arranged, religiously followed work schedule and system of reporting complaints and work done. At Empire State, the highest and one of the largest buildings in the world, there are 73 elevators. The elevator engineer is directly in charge of all electrical and mechanical work on the equipment, and reports to the building management.

We have divided the elevators into four groups. Regular inspection and maintenance of each is done by a mechanic and his helper on the day shift, with the exception of the hoistway and car doors. All doors are inspected, cleaned and adjusted by a mechanic and helper, on the early night shift. During the early morning shift we keep a mechanic on duty so that the elevators are always in charge of a responsible man.

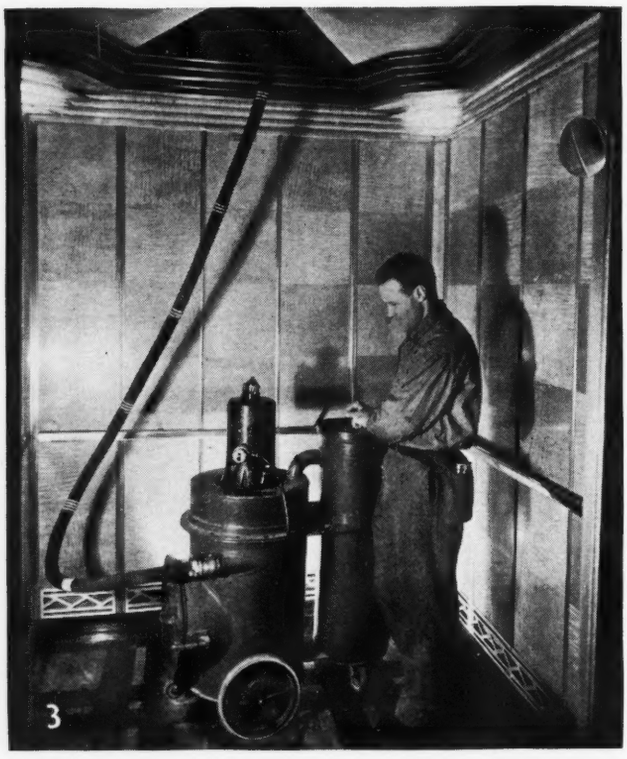
A repair and machine shop for light work is manned by a machinist who serves as general repair man. Adjoining the shop are the stock room and office. My assistant and myself complete the elevator maintenance organization of 14 men, who do all work of maintaining the elevators, even replacing ropes and regrooving the sheaves.

No matter how carefully equipment is inspected and maintained, complaints occasionally develop. To insure prompt attention, each elevator machine room has a phone on which the mechanic and his helper can be called. Each bank of elevators has a phone outside the pits. A phone is also part of each starter's panel and each car has one. All these phones communicate directly to the maintenance office in the elevator repair shop where an attendant is always on hand.

A plug board is provided with a row of plug holes for each member of the elevator maintenance organization. Each row of plug holes has a position for every phone on the elevator system. Every man reports where he is going to work and his plug is put into the telephone position where he can be reached. Then, if he is wanted, he can be called immediately at that position.

Taking Care of Complaints

All complaints of improper car operation are made by the starter directly to the maintenance office man who relays the complaint to the mechanic in charge of that bank of elevators. The date of the complaint, time it was made, time that the mechanic reported it cleared, nature of the complaint, on what bank and the car numbers, cause of the trouble and if the car was detained, are all recorded on a log sheet, Fig. 4, by the shop mechanic. This log provides a complete unbiased record of all complaints against the elevators, their cause and how long it took to clear them. Only when a car stops between floors with passengers does



Figs. 2 and 3—Once a year the elevator hoistways are cleaned with a large portable vacuum cleaner taken into a car

the car operator report directly to the attendant in the maintenance office. In all other cases he makes the complaint to the starter who, if a mechanic is needed, reports to the maintenance office.

Inspection and cleaning of elevator equipment is done according to a schedule, Fig. 5. This schedule permits a mechanic to complete easily his assignment each day, except on rare occasions when something unusual happens. The schedule is shown made out for the month of February, for three banks of elevators. A key to the schedule is given in Fig. 6.

Elevator Maintenance

On Thursday, Feb 1, on *A* and *B* banks of elevators, the schedule calls for item 11 on the key sheet to be completed on elevators 1 to 4 in *A* bank, and on elevators 1 to 3 in *B* bank. This work consists of graphiting leveling-switch cores, cleaning air dash pots, selector segments, and floor bars. On Friday, Feb. 2, the schedule on *A* and *B* banks calls for item 10 on the schedule sheet to be performed on *A* bank of elevators. This requires blowing out and cleaning the main motors, motor-generator sets and the controllers.

Every day each mechanic makes out a report on the form, Fig. 7, showing the work done. From these reports and the log sheet, two consolidated reports, compiled for each elevator, are kept in a post index. One of these reports, headed "Repairs and Replacements," records the date a repair or replacement was made, the item repaired or replaced, indicated miles on the mileage recorder when the repair or replacement was made, the work done and the service miles of the item repaired or replaced. From this sheet the service record of any part of the equipment can be readily determined.

Form 041 8-31 - P

ELEVATOR DAILY LOG

Date	Time	Time Clear	COMPLAINT	Origin	Bank	Car	Cause and Remarks	Pass. Det.

Fig. 4—All complaints against elevator service are recorded on this daily-log sheet

The other report, "Complaints and Detentions," records all complaints against the elevator service whatever the cause. This report gives the date of the complaint, time reported and time cleared, complaint as reported, number of passengers in the car if it was detained, length of time the car was detained, and cause of the detention. This record gives us a continuous picture of how reliable each car is. We have been able to reduce the number of complaints against the elevators to an almost negligible quantity. When one does occur, it is cleared, on an average, in about four minutes from the time the complaint is received in the maintenance office.

Inspection of all ropes is done under my direction and regular inspections are made every three months. This job is really a cooperative one between our own organization, the insurance inspector and the city inspector, to make certain that the ropes are safe, yet not condemn them when they are safe. When ropes give indications that make us suspicious of their condition, they go on the inspection schedule to be inspected once a week or two weeks as the condition seems to justify. If, before the time of the regular insurance or city inspection, the ropes appear to be ready for replacement, we call in these inspectors and if they are condemned we replace them.

How frequently inspections are made, of the different parts of the equipment, is indicated on the right-hand end of each item on the schedule sheet, Fig. 6. For example, item No. 1—selectors, governors and tape drive equipment—are cleaned and lubricated every week

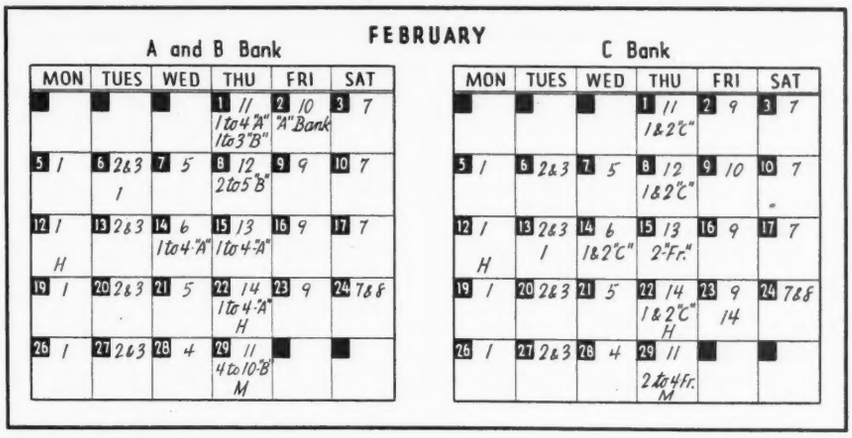


Fig. 5—Elevator maintenance work schedule. Top number in each square is maintenance item called for in Fig. 6. Lower number refers to elevator

on Monday. Likewise, each week, items 2 and 3 are taken care of. Item No. 4—fill rail lubricators, check oil level in counterweight buffers, and inspect the ropes as per instruction—is performed once each month. There is no particular reason for the length of time between inspections, other than experience has shown this meets requirements for maintaining the machines in a high state of repair.

Cleaning of equipment is handled in three ways: Wiping with cloths, vacuum cleaning and compressed air. Wherever possible, portable vacuum cleaners are used. One of these units, that can be carried around by a mechanic, is provided for each motor room. Dirt in places that cannot be readily removed with a vacuum cleaner is blown out with compressed air and then picked up with the vacuum cleaner. The final cleaning is done by wiping with rags. Compressed air for cleaning is provided by a small compressor and receiver mounted on a truck easily portable from one motor room to another.

Cleanliness

We lay great stress on cleanliness because a clean machine is usually a reliable one. Probably this is true because, in doing a careful cleaning job, little defects are found and corrected before they have a chance to develop into trouble. We find that when we keep equipment thoroughly clean we don't have much to worry about.

We even go so far as to clean thoroughly the hoistways and wash down the guide rails once each year. In this work, for removing all dust and loose dirt, we use a large portable vacuum cleaner. This we take into the car and extend the hose up through its top, where the cleaning nozzle can be readily used on the hoistway walls and other parts. On this job we get some extra help from building-janitor department.

Each elevator room has a work bench with a locked drawer for the mechanic's tools and a vise. This permits the mechanic to make easily minor repairs, clean contacts, etc. Each control room is also provided with a glass-front locked case in which are kept three fuses of every size used on the elevators. If a fuse blows, the mechanic replaces it from the case, turns the blown one into the repair shop for inspection and refilling, and puts another fuse into the case. The glass front in the fuse case permits me or my assistant, when making our daily general inspections, to see that all fuses are in place. Having all fuses filled in the shop insures proper refilling.

Good jobs are done only by a loyal and faithful organization. We try to treat everyone in the organization the way we would expect to be treated. Effort is made to arrange the work so that everyone can normally take care of his job easily. If emergencies develop we all jump in and help out. If trouble occurs on an elevator that the mechanic cannot readily handle he knows he can call upon the head of the department for assistance without having it in any way reflect against him. The whole organization feels that it is their job to give safe and highly reliable elevator service and everybody works towards a 100% job.

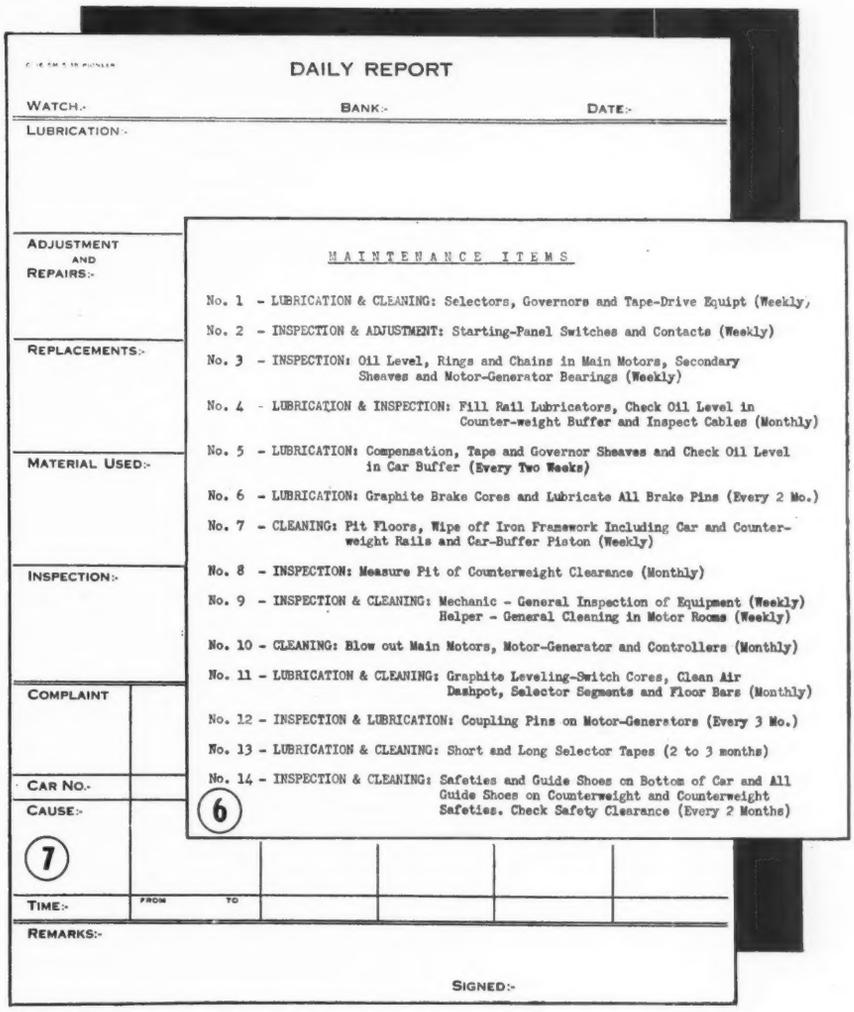

DAILY REPORT
WATCH:-
BANK:-
DATE:-
LUBRICATION:-
ADJUSTMENT AND REPAIRS:-
REPLACEMENTS:-
MATERIAL USED:-
INSPECTION:-
COMPLAINT
CAR NO.-
CAUSE:-
7
TIME:-
FROM
TO
REMARKS:-
SIGNED:-
MAINTENANCE ITEMS
No. 1 - LUBRICATION & CLEANING: Selectors, Governors and Tape-Drive Equipt (Weekly)
No. 2 - INSPECTION & ADJUSTMENT: Starting-Panel Switches and Contacts (Weekly)
No. 3 - INSPECTION: Oil Level, Rings and Chains in Main Motors, Secondary Sheaves and Motor-Generator Bearings (Weekly)
No. 4 - LUBRICATION & INSPECTION: Fill Rail Lubricators, Check Oil Level in Counter-weight Buffer and Inspect Cables (Monthly)
No. 5 - LUBRICATION: Compensation, Tape and Governor Sheaves and Check Oil Level in Car Buffer (Every Two Weeks)
No. 6 - LUBRICATION: Graphite Brake Cores and Lubricate All Brake Pins (Every 2 Mo.)
No. 7 - CLEANING: Pit Floors, Wipe off Iron Framework Including Car and Counter-weight Rails and Car-Buffer Piston (Weekly)
No. 8 - INSPECTION: Measure Pit of Counterweight Clearance (Monthly)
No. 9 - INSPECTION & CLEANING: Mechanic - General Inspection of Equipment (Weekly) Helper - General Cleaning in Motor Rooms (Weekly)
No. 10 - CLEANING: Blow out Main Motors, Motor-Generator and Controllers (Monthly)
No. 11 - LUBRICATION & CLEANING: Graphite Leveling-Switch Cores, Clean Air Dashpot, Selector Segments and Floor Bars (Monthly)
No. 12 - INSPECTION & LUBRICATION: Coupling Pins on Motor-Generators (Every 3 Mo.)
No. 13 - LUBRICATION & CLEANING: Short and Long Selector Tapes (2 to 3 months)
No. 14 - INSPECTION & CLEANING: Safeties and Guide Shoes on Bottom of Car and All Guide Shoes on Counterweight and Counterweight Safeties. Check Safety Clearance (Every 2 Months)
6

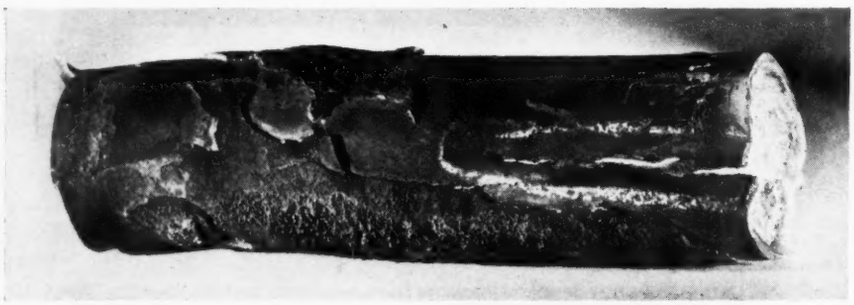
Fig. 6—Items of maintenance called for on the work schedule. Fig. 7—Daily report sheet made out by the mechanic in charge of each group of elevators

EXPERIENCE ON SUPERHEATER OPERATION

IN FEBRUARY'S ARGUMENT CORNER, Mr Armstrong, Power Production Supt, Trinidad Transmission, Railway & Gas Co, Trinidad, Colo., took issue with S H Coleman's "Ins and Outs of Boiler Outage" as follows:

"Under the heading 'Returning Boilers to Service' it was stated that superheaters should be drained before starting a fire in the boiler. It has been proved by experience that it's much better to leave all superheaters with water in them until pressure is established in the unit, and the water should not be drained out until just before the main valve between the oncoming unit and the main header is opened. In this way the superheater is protected from overheating in the starting-up period."

This brought letters from three more POWER readers—here are their ideas:



Scale caused failure of this superheater tube. Note inner surface

Harry Spring, Canton, Mass., comments that there are two general classes of superheaters in modern practice; convection units, located behind the first bank of generating tubes, which receive heat from the hot gas; radiant units, located where directly exposed to the "light" of the fire, which receive heat by radiation. In general, radiant units are used in high-capacity steam generators. This type has a rising temperature characteristic (steam temperature increases as combustion rate and load rise) and is often used with a convection superheater which has a drooping characteristic. This combination gives a close approach to constant total temperature over the load range. Operation of boilers equipped with superheaters should follow closely manufacturer's recommendations, to avoid costly repairs.

The "argument" seems to apply only to convection superheaters so the following remarks apply only to this type. There are three common convection-superheater constructions; these have a direct bearing on the question of draining. The reverse pendant type is the only one that can be drained completely. About one-half the multiple-bent-tube superheater may be drained and the pendant type can't be drained at all. If it is desired to remove condensate from these latter types, they must be blown out with compressed air.

Years ago, operators commonly filled superheater tubes with water before starting the fire. This was called "flooding" the unit, and it was required to prevent tubes from overheating. In those days, the low-carbon steel or lap-welded iron tubes in common use could be damaged at about 1300 F, so failure to flood would be inviting probable trouble. Modern tubes will safely withstand much higher temperatures and it is seldom necessary to flood a modern super-heater if care is taken to maintain low combustion rates until the "cooling" effect of steam flow is established.

So much for the absence of any *need* for having the superheater full of water. Now, as the superheater-outlet vent valve should be open until the boiler goes on the line, any condensate remaining in the superheater when the fire is lighted will be vented as steam in a short time. The "argument" comes down to the point that one type of superheater can be drained and two cannot, so why try to remove the condensate? Evidently makers of the types that cannot be drained feel that no serious harm will result and that added heating surface in available space overcomes any objection to water pocketing in the superheater tubes when the boiler is idle.

However, if the boiler is to lie idle for any extended period, the operator should blow the superheater tubes if they cannot be drained. If this is not done, it is possible that internal corrosion and pitting will develop to a point causing tube failure.

Carryover

Consideration must also be given to the fact that carryover will have left a certain amount of deposits in the tubes. These deposits may be a powder or light incrustation and either may be soluble in water. The condensate may thus become scale-forming when it is evaporated. Scale in superheater tubes invites failure, as the photo of a tube section shows.

Firing a boiler with a dry superheater demands care. The combustion rate should be kept low until steam flow is established through the vent. In cases where burner size, location or other factors make it difficult to prevent excessive gas temperatures in the superheater region, the operator should go to intermittent firing. That is, the burner should be operated for say ten minutes, then shut off for five minutes, until steam flows.

In the early days of superheaters, says W F O'Regan, Dorchester, Mass., flooding pipes formed part of the installation. Operators finally found them to be more of a hindrance than a help in superheater operation. Flooding was a prolific source of scale formation when water wasn't the best, and there always came a time when the operator didn't drain the superheater when cutting in, with the result that water carried over to the prime movers and auxiliaries. These conditions caused a change in methods and it is now standard practice to have superheater drains open when the boiler goes into service and when it comes out.

The drain valve should be open wide enough to get a large flow of steam through the superheater and under no conditions should there be a trap in this line. Many operators find it convenient to have a saturated steam connection from another boiler to the superheater, to give a flow of "cooling" steam when a boiler has to be put on the line in an

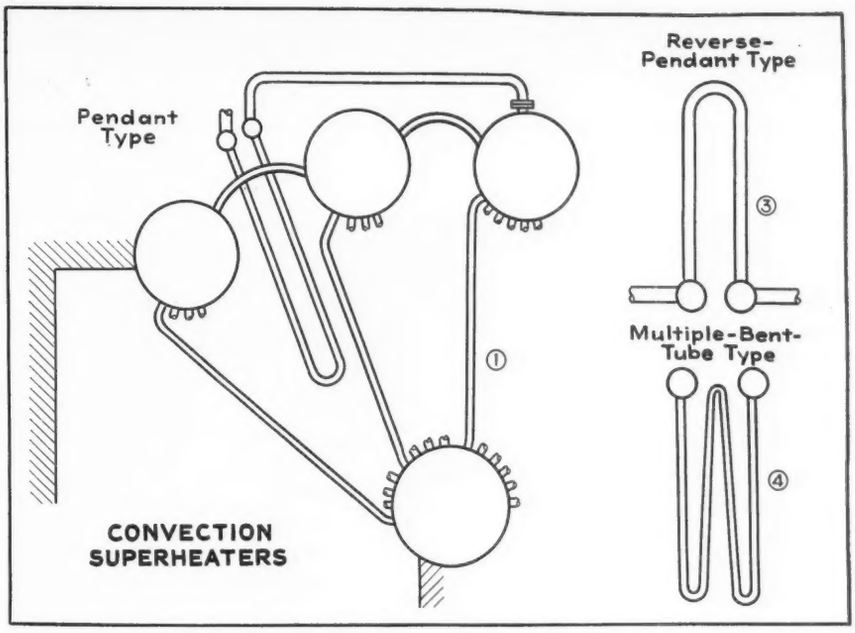
emergency rush. When steam demand falls off suddenly, superheater safety valves should open before the boiler safety valves to protect the superheater surface by maintaining a flow of steam.

Flooding the superheater isn't the only source of scale formation. Unsuspected scale often forms from carry-over of wet steam from the boiler drum, making the superheater part of the evaporative surface. Operators should watch closely quality of steam entering the superheater. Radiant superheaters are worse offenders than convection units, because they get the full effect of furnace heat.

Mr Armstrong's operating conditions may be ideal so that he has never experienced any of these troubles. I am, however, voting Mr Coleman's way. It's cheaper to waste a little steam at the superheater drains than to repair superheaters.

Flooding Unnecessary

Both Mr Armstrong and Mr Coleman may be outlining good practice, depending on the type of superheaters to which each refers. According to W H McKinney, Arlington, Va., experience with interdeck and overdeck types designed for total steam temperatures of 725–825 F leads to the belief that flooding is unnecessary. One unit, designed for 825 F steam, is so located with respect to flue-gas travel that maximum temperature lies in the neighborhood of 1150 F at full load with normally slagged heating surfaces. The low heat release required to raise to working pressure causes no overheating because of the water-wall and generating-tube surface ahead of the superheater.



Convection superheaters: pendant, reverse pendant, and multiple-bent-tube

Usual procedure allows from one and one-half to two and one-half hours for lighting off and cutting in, divided approximately evenly between firing and "drifting." This means from 50 to 80 minutes of firing time during which outlet drains are open wide to insure flow in the desired direction through the superheater. Drains may be throttled during drifting periods to save condensate, deaden sound, and ease flash tank.

Radiant superheating surface in high-heat-release zone may present an entirely different problem during the period of raising steam temperature.

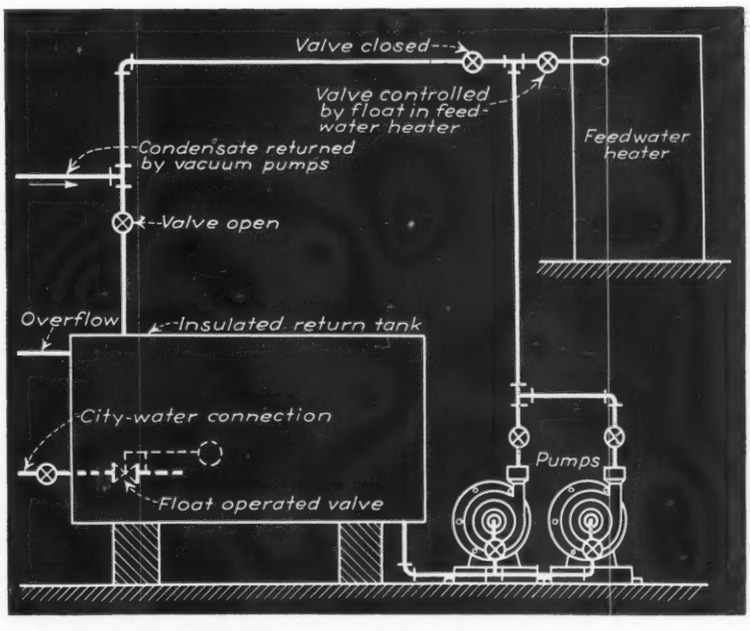
✦ ✦ ✦

Makeup Water Reduced 50%

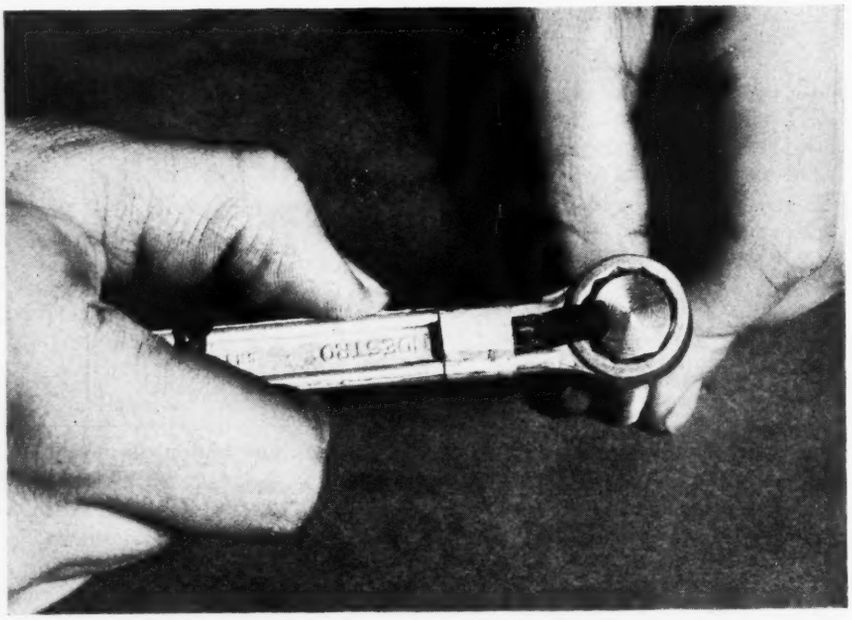
By H P KING, *Rochester, N. Y.*

IN THE ORIGINAL LAYOUT of our power plant, heating-system condensate was returned intermittently by motor-driven vacuum pumps directly to the feedwater heater. The heater was not large enough to hold the flow for any one operation of the vacuum pumps and overflow went to the sewer. Before the pumps operated again makeup from the city main had to be supplied to the heater. This caused a large loss of condensate and required about 40% makeup.

To correct this condition we put a well-insulated return tank in the basement and connected the return-water line to it, as in the figure. A float-controlled makeup connection comes into this tank from the city main, so that all makeup water mixes with the condensate before going to the heater. Duplicate centrifugal pumps discharge the water from the return tank to the heater, through a float-controlled valve. Now the heater no longer overflows and the makeup has decreased to 20%, a decided saving in both makeup water and in steam for heating the water.



PRACTICAL AIDS TO OPERATION

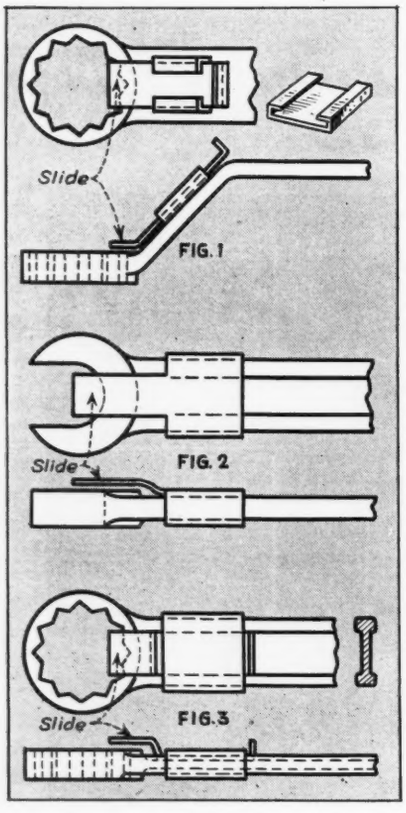


Device Makes Wrench Stay on the Nut

EVERY MECHANIC KNOWS that wrenches have a tendency not to stay where they are put on a nut or bolt head. The photograph and drawings show a simple little device I have applied to my wrenches to keep them in place without much attention. It comprises a sliding keeper made of a thin piece of spring steel, held in a sleeve fastened to the wrench.

When the keeper is not required, it can be pushed back and the wrench is used as if the keeper did not exist. This device does not in any way weaken the wrench and can be used on offset wrenches, Fig. 1. just as on straight open-end or socket designs, Figs. 2 and 3.

Englewood, N. J. R BOETTINGER

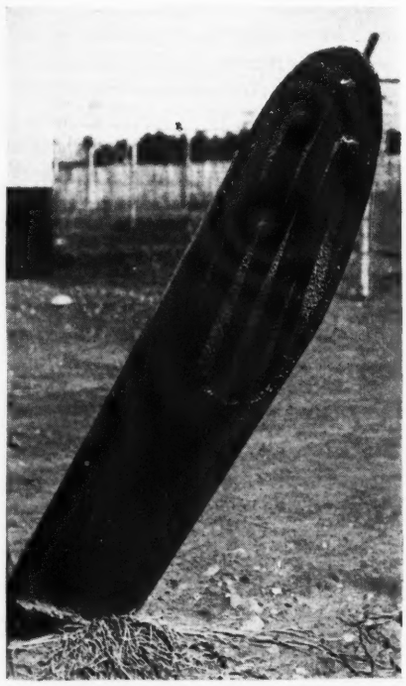


Low-Watt Lamps Cure Gage Troubles

WE EXPERIENCED a great deal of trouble in keeping our boiler-room pilot pressure gage from being sluggish. The pointer on this gage is in a vertical position when header steam pressure is normal, with a dial range reading 15 lb either side of this value. The gage must be sensitive to give a reliable operating guide. Despite all we could do, however, dirt and gummy deposits accumulated on the gage mechanism, making operation sluggish and jerky and occasionally throwing the instrument out of calibration altogether. Scheduled cleaning gave some relief, but required a considerable amount of time.

We finally hit upon the cause of the trouble. Inside the gage casing are two 60-watt lamps to illuminate the translucent dial. Heat generated by these lamps made the internal temperature so high as to cause the casing joints to breathe, allowing air, carrying particles of dust, to circulate and deposit dirt on the gage parts. Replacing the large lamps with 10-watt bulbs has overcome most of the troubles and gage performance is now as nearly perfect as can be expected. This experience emphasises the necessity of keeping the inside of gages and instruments clean.

Bethesda, Md. S H COLEMAN



Grille Prevents Fouling Exhaust Pipe

STUB ENDS OF EXHAUST PIPES on slow-speed internal-combustion engines on one of our isolated installations were frequently stopped with tin cans and other debris, requiring clean-outs which delayed operation. Investigation showed that the trouble was caused by children using the exhaust pipes as cannons to shoot out the cans they put into pipe between exhaust pulsations.

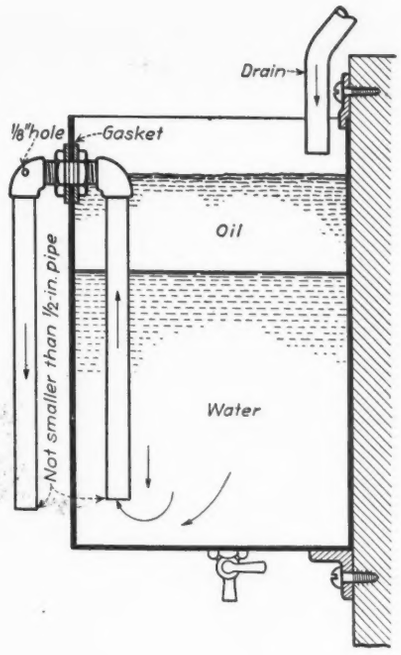
We completely prevented this trouble by welding a grille of heavy rods across the beveled end of the pipe, as in the

photo. This screened the pipe against cans and other debris with little or no obstruction to exhaust gases. Since installation of the grilles we have not had to clean the exhaust pipes out and no further accidents to children have been reported.

Longview, Texas ELTON STERRETT

Drain Container Saves Oil from Engine Drips

THE AMOUNT OF LUBRICATING OIL leaking from crank cases of reciprocating engines through packing glands is usually small in comparison to the water. For this reason, drain cans full of water and a film of lubricant are usually dumped with no regard for the oil. To save this oil I made up the drain container shown in the figure. Water drains from the bottom when the liquid level rises to the highest point on the drain line. Quantity of oil increases



continually until it reaches to the bottom of the can. It is not necessary to dump the container every time it is full, but only when oil starts dropping from the overflow pipe.

To make the container, I cut a hole for a ½-in. pipe about 2 in. from the top of a square varnish can and inserted a ½-in. nipple with a continuous thread. An oil gasket and metal washer were then placed over each end of the nipple and the latter tightened to the container with two split nuts which had been tapped through with a pipe tap. A 90-deg. elbow and a length of pipe on each end of the nipple completed the overflow. A drain cock was fastened into the bottom of the can for draining out the oil. To prevent syphoning liquid from the container, I drilled a ⅛-in. hole in the outside elbow. The drain pipe should be at least ½ in. in diameter, and should not extend to less than 2 in. from the bottom of the container. This will help to prevent sludge from getting into the drain and clogging it.

New York, N. Y. S M ELONKA

Manually Operated Valve Controls Steam Pressure

IN THE EMPIRE STATE BUILDING heating steam is purchased at about 150-lb pressure and delivered to the heating mains at 3-lb pressure or less, depending upon the outside temperature. Originally, steam for the direct-heating system was reduced through 4 valves in the different mains. These required maintenance and at night steam was cut out of the heating mains, until the next morning, by closing a hand-operated valve.

Because of these conditions and due to the heating pressure being under close supervision we decided that considerable saving could be made by controlling steam pressure manually. To do this job we had a 5-in. special orifice valve built with a hardened-alloy-steel seat and disk, which we installed in place of the original cutoff valve, at *V* in the photo.

The new valve stem has six threads per inch and the operating wheel six spokes. Opening the valve one turn of the handwheel passes approximately 12,000 lb of steam per hr and 1/6 turn, as indicated by the space between any two spokes, passes 2000 lb per hr. Having established this calibration of the valve we can control steam flow within very close limits.

We have established quite closely the valve settings required for different outside temperatures. Except for an occasional setting, when the outside temperature changes a few degrees, the valve requires very little attention to hold our steam needs within close limits. In fact, it has worked so satisfactorily that we have installed a similar valve to control steam to the tempering stacks

on the building indirect-heating main.

The close attention we give to control of heating-steam requirements is paying handsome dividends, as we are now using only about 0.4 lb of steam per 1000 cu ft of heated volume per degree day compared to an estimated value of 0.75 lb.

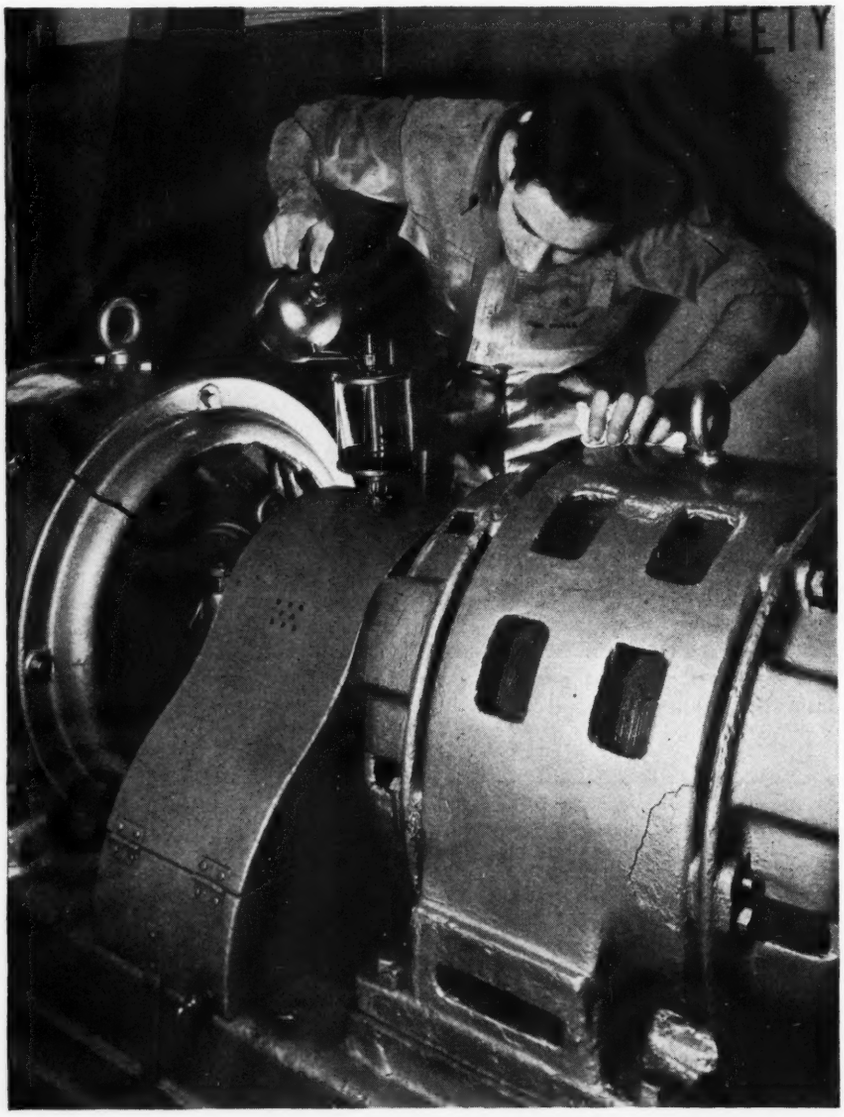
New York, N.Y. C F WENDLAND
Chief Engineer, Empire State Bldg

Copper Strips Destroy Armature-Coil Insulation

A LITTLE KNOWLEDGE is sometimes a dangerous thing. An armature winder rewound a semi-closed-slot armature and when the job was done found that it was out of static balance. To put the armature in balance the winder put bare copper strips in some of the slots.

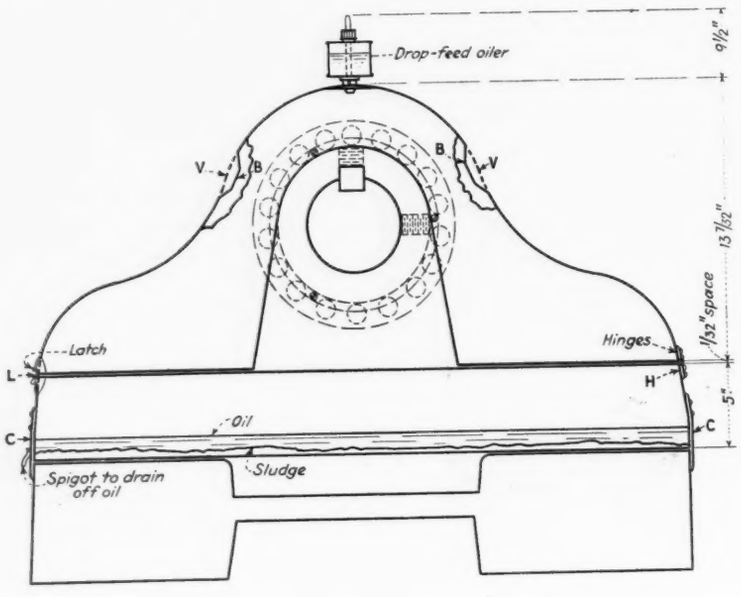
After the machine was in service for a few weeks the winding again burned out. When it was opened up the coils next to the copper strips were found to have their insulation badly charred. These copper strips in contact with the iron core formed a closed circuit in which sufficient current was generated to overheat the strips and destroy the insulation on the winding.

Chicago, Ill. J B MULLINS



Lubricator Eliminates Coupling Troubles

ON OUR ELEVATOR motor-generator sets, the flexible couplings did not permit proper float of motor and generator rotors. We also had trouble with pins breaking. In running down the cause of this trouble we found the coupling pins so rusted and gummed up that they were practically fixed in their holes. It was evident that thorough lubrication was necessary to put the couplings in good working condition and to keep them properly maintained. To do this, we built the lubricator shown in the drawing and photo.



The lubricator has a casing made of No. 20-gage sheet iron supported around the coupling from the machine bedplate and held in place by cleats *C* at each end. The top half of the casing is hinged at *H* and is latched closed at *L*. Ventilating holes at *V* are protected by baffle plate *B*. A large drop oiler on the top of the casing feeds oil to the coupling. This unit was made in our machine shop and all joints in the sheet-iron casing were welded.

We fill the oiler once or twice a day and let the oil gradually feed onto the coupling. Oil and dirt from the coupling accumulates in the bottom of the casing. After the sediment has settled out of the oil, the latter is drawn off and used again. This process is repeated for about two weeks when we move the lubricator to another machine to lubricate its coupling.

We have found that, by giving the coupling thorough lubrication every

three months, they remain free and in good working condition. This treatment not only lubricates the coupling but washes all dirt and rust out of it. The large amount of sediment found in the bottom of the casing after lubricating a coupling is surprising.

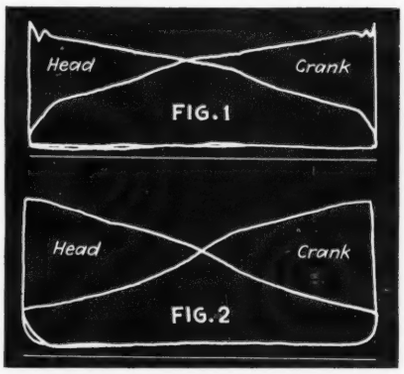
New York, N. Y.

WILLIAM DEVAUGHN
Elevator Engineer, 40 Wall St Bldg

Valve Changes Stops Steam Engine Pounding

ABOUT TWO YEARS AGO I took charge of a steam-engine-driven air-compressor station, in which one of the units was driven by a piston-valve compound engine exhausting to a condenser. The valves took steam at their centers and exhausted at their ends and were fitted on the inside with hand-controlled cut-off valves. Range of cutoff of both cylinders was 25 to 75% stroke.

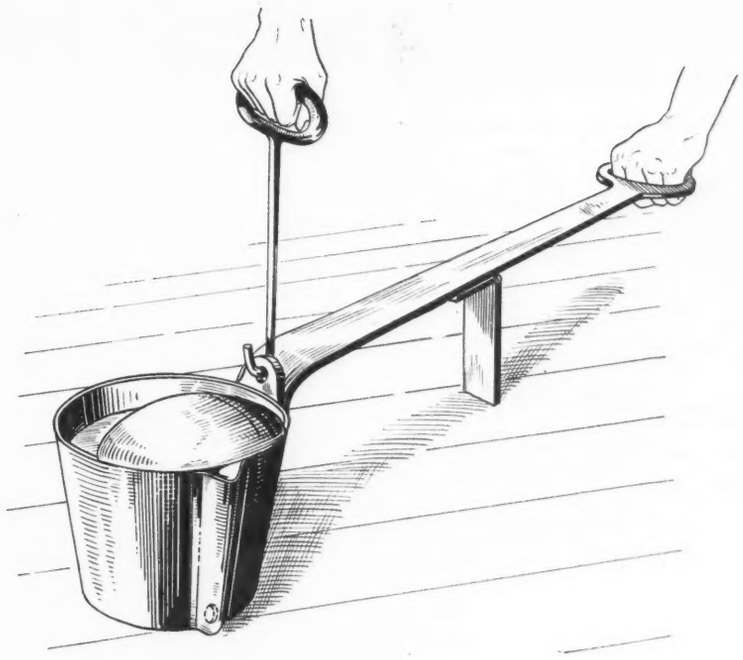
With this arrangement just about anything could be done with receiver pressure, as speed was controlled by throttling governor. In spite of the changes possible, the high-pressure cylinder had a very heavy pound on each end of the stroke. Alignment, bearings and lubrication were checked carefully and some changes were made. The indicator cards showed no compression, Fig. 1. Admission was 2 to 3 deg before center and exhaust opened



earlier than other units of similar design that ran satisfactorily. Men in our employ when the compressor was installed advised that this condition always existed.

To correct this condition we made cast-iron rings threaded on the inside and on the outside turned to the diameter of the main valves. We turned off the exhaust ends of these valves and threaded them to take the rings. We increased the exhaust lap in steps by using wider rings. The final rings used gave results indicated by the cards, Fig. 2. The compression obtained was enough to remove the heavy pound. Sloping off of the steam line on the cards is due to the throttling governor being close to the high-pressure valve chest. Thus, there is not sufficient steam volume between the valve and chest to maintain pressure until cutoff takes place.

Buffalo, N. Y. R E FONTAINE



Safe Babbitt Ladle

THE DRAWING SHOWS a babbitt ladle used in our shop that is both practical and safe. The pouring spout is of generous proportions and the metal enters it from the bottom of the ladle, thus insuring clean metal free from dross. A half-section lid inside the ladle prevents spilling metal. Both the spout and lid are welded onto the side of the ladle.

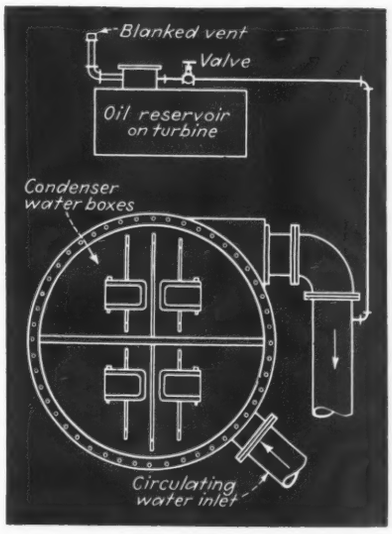
A safety lift eye permits lifting the ladle by a hook with a minimum of effort. The long eye grip in the handle end allows a good grip to control lifting and pouring operations. A safety hinged foot permits setting down the ladle without danger of the handle tipping it over.

Penacook, N. H. C H WILLEY

Oil Vents Into Condenser Tail Pipe

OPERATING TEMPERATURE of turbine oil is around 100 F or higher, and there is considerable vapor given off through the vent to the outside or into the turbine room. Oil vapor in our turbine room was objectionable so we installed a vacuum vent on the oil reservoir as in the figure.

This arrangement connects the space above the oil reservoir with the condenser circulating-water tail pipe. At the point where the connection is made to the tail pipe, a 9- to 10-in. vacuum exists, which is sufficient to pull the vapors out of the oil reservoir.



A globe valve on the ¾-in. pipe is handy to get at and is used to regulate venting of the reservoir. This valve is closed when the unit is shut down and during starting, but it is partly opened when running. We have found that ¼ to ½ turn is sufficient to vent the oil reservoir.

Beaumont, Texas G F BRILL

READERS' PROBLEMS

Questions from Our Readers

Cleaning Soot from Boiler Tops

Question 1

WE ARE INTERESTED *in learning of a good way to clean soot from the tops of our boilers. Have any* POWER *readers built home-made vacuum cleaners or other devices for making this job less of a nuisance?*—WHH.

Dissolving Sludge

Question 2

WE HAVE BEEN URGED *to use various chemicals for dissolving sludge in boiler No. 6 (Bunker C) fuel oil. We have tried several but have no means of accurately checking their value and so cannot arrive at any definite opinion. Have* POWER *readers had any experience with compounds of this type, and have they been able to come to any definite conclusions as to their value?*—AAB

Reducing Fan Speed

Answers to March Question 1

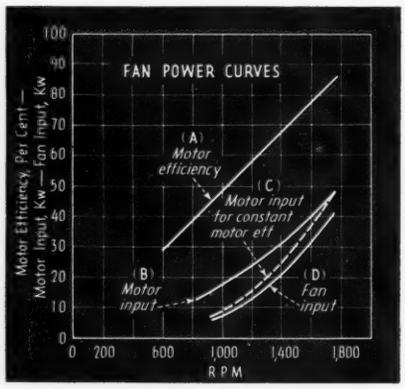
The Question

AN INDUCED-DRAFT FAN *driven by a direct-connected, 50-hp, 1750-rpm slip-ring motor requires approximately 55 hp at 1750 rpm with open damper. However, the fan is never operated at this speed, but usually runs between 1100-1400 rpm. Rotor resistance is inserted to cut the speed. The arrangement is inefficient, and I would like to know if there is a practical and more economical way to operate this fan. Wouldn't reconnecting the stator for a higher voltage, and allowing a higher slip with resistance cut out, be better?*—NK

Install Inlet Vanes

RECONNECTING the stator winding of an induction motor for a higher voltage will not greatly affect the speed. Current frequency controls the speed of an induction motor and since frequency is usually fixed, rewinding to change the number of poles remains as the only way to change speed. The frame, and thus the magnetic circuit of the motor, may not permit such rewinding. The only motor speed, near the operating range, that the motor might be rewound for is 1200 rpm. This is lower than the 1400 rpm stated and thus will not do.

To improve the economy of the installation, fit the fan with inlet vanes and run the fan at rated speed of 1750 rpm. If NK will do some figuring, he might find that his arrangement is not so inefficient as he thinks. If he balances the extra cost of power at light loads, due to the lower efficiency of the slip-ring motor at reduced speeds, against the cost of installing inlet vanes he will find whether or not the installation will pay. The curves below show power consumption at various



fan speeds. Curve *B* takes into account the lowered efficiency of the motor when operating at reduced speeds. Curve *C* considers that the motor will have the same efficiency at reduced speeds as at rated speed. The maximum amount of power that might be saved in operation would be the difference between these curves, at any speed lower than rated speed.

University, La. G. F. MATTHES

Efficiency Not So Bad

IF NK WILL CHECK power input to the fan motors with meters, he will probably find that the power losses are not as great as he thinks. Power to drive a fan varies approximately as the cube of the speed. Therefore, the power to drive the fan at 1100 rpm is about 25% and at 1400 rpm 50% of that required at 1750 rpm. Of course, a wound-rotor motor is not the most efficient way of adjusting fan speed, but it has advantages that make it most economical for many installations.

If space permits, a reduction gear, a chain drive, or a variable-speed transmission might be installed between fan and motor to reduce fan speed. It is doubtful, however, if such an arrangement could be justified economically, and it means an extra piece of equipment to be maintained in the high-temperature and dirt that usually surround an induced-draft fan.

It will not help to reconnect the stator winding for a higher voltage because the speed of an induction motor depends on the number of poles in the stator and the frequency of the power supply and not on the voltage applied to the stator. If the present windings are delta connected, they can probably be regrouped for 6 poles but this would be rather expensive because both stator and rotor windings will have to be changed. Six poles would give a top full-load speed of about 1150 rpm, too low for this service. A polyphase adjustable-speed motor could be installed but old man economics and other considerations say no. Under the circumstances, there doesn't seem to be much NK can do to improve the efficiency of his induced-draft fan drive.

Philadelphia, Pa. R A WIGGINS

Installing Globe Valves

Answers to March Question 2

The Question

I HAVE HEARD *that globe valves should be installed with pressure above the disk and also that they should be installed with pressure below the disk. It looks to me as if the answer depends on the situation, that is, on whether you want the valve closed or open after the stem breaks or something else happens. I'd like to know whether other* POWER *readers agree with me on this, and if they do, whether they will give me some ideas as to location where valves should be installed.*—MEF

How to Use Valves

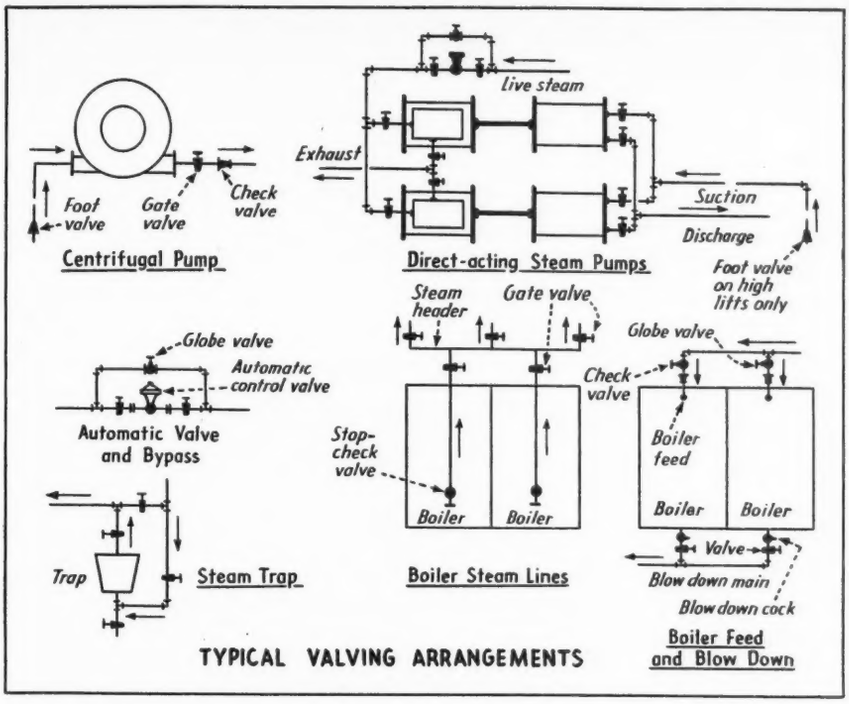
I THINK THAT MEF has himself found the one answer to the question of whether a globe valve should close with or against the pressure. The answer depends on the situation, although it is generally better to have the valve close against the pressure, since, if the disk comes loose from the stem with pressure on the top, it is impossible to get the valve open while in service.

The last part of the question, asking for an idea as to when and where to install valves looks, at first sight, like an impossibly large order, but it is really a good question. Most of us have, at some time, found ourselves in trouble through neglect to install all the valves which have later appeared to be desirable. Perhaps a statement of a few general principles may help. It should be understood that the following are recommendations rather than unbreakable laws and should be applied with judgment:

1—Globe, angle and similar valves should be used for control or regulating purposes. Gate valves should be used as shutoffs only, but for this purpose they are preferred, as they offer little resistance to flow when open.

2—All branches to or from a header or main should have gate valves near the main so that the branches can be worked on, without interfering with service.

3—Wherever reverse flow is to be avoid-



ed, especially where liquids are pumped against a head pressure, check valves should be installed. The discharge from centrifugal pumps should be guarded in this way to prevent damage to the casing from surges.

4—Reducing valves and similar specialties, which are subject to adjustment or repair, should be installed with unions and gate valves at each end, and the gate valves should be bridged with a bypass, fitted with a globe for hand control.

5—When globe or other valves are installed for control of any steam apparatus, the engineer should consider the advisability of installing a gate valve as well, for shutting off the feed branch.

6—When two or more pumps or other pieces of apparatus are connected to the same system, they should be valved so that any one of them can be shut down or removed, without interfering with operation of the others.

7—On high-lift suctions, and with centrifugal and other pumps which require priming, foot valves should be installed at the end of the suction line.

8—Boilers, tanks, and similar equipment, as well as the low point of any piping system containing fluid, should have draw-off cocks or valves to permit complete drainage.

9—Manufacturers of special equipment will generally furnish diagrams showing connections and valving. Get these diagrams and follow them.

The chief difference between a well-designed system and a poor one is often a matter of adequate valving. With all that, it is generally better to have too many valves than too few.

Bloomfield, N. J. J O G Gibbons

Reasons For and Against

With pressure on top of the disk, the operator can repack the valve only when it's open; with pressure under the disk, the job can be done with valve open or closed. When pressure is on top of the disk, the valve is apt to close tighter, particularly on medium and high-pressure lines, such as to soot-blowers, drips and drains, and other lines to atmosphere. When such a valve cools, contraction may cause steam to leak under the seat, but if installed with pressure above the stem, it cools less and the pressure helps keep it tight.

With pressure on top of the disk, a globe valve used as an engine throttle will close automatically and stop the engine if the valve fails. With pressure under the disk, the valve will be held open and make it difficult to stop the engine. Always install globe and angle valves in boiler-feed lines with pressure under the disk, to avoid shutoff of water supply to boiler, if valve stem fails.

Brockville, Ontario E A Clamp

Really Two Questions

It seems to me that MEF has asked two questions: (1) the direction of setting globe valves, and (2) the location of globe valves. MEF is right when he says that the first answer depends on location. By listing advantages of each method it will be easy to decide which to use in any case.

Large valves or high pressures indicate installation with pressure under the disk; there seems to be no question about this. Under other conditions, installation with pressure under the disk permits packing with the valve closed and prevents the stem from pulling out of the disk when the valve is opened under pressure. A third advantage lies in the fact that upward direction of flow causes less erosion of the seat.

Against all these advantages about all that can be said in favor of having the pressure on the disk is that the pressure holds the disk to its seat and when the line cools down the lost motion between the disk and spindle allows the disk to follow the contraction of the valve body and when steam is again turned on the valve is tight.

Questions about location of valves do not lend themselves to general consideration, as this depends almost entirely on local conditions. Two important pointers are: (1) arrange pipe and valves so that the purpose is obvious, as for example, pump valves near pumps, etc, and (2) piping and valves should be readily accessible.

Lakewood, Ohio J P Simons

Install Globes to Close Against Pressure

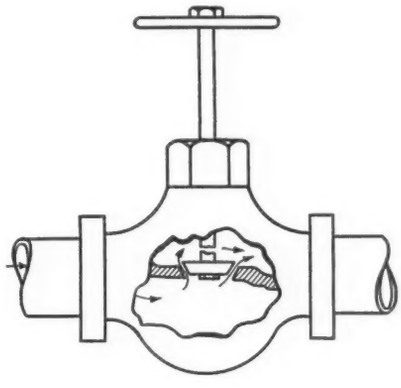
Globe valves should be installed to close against the pressure, otherwise the valve could not be opened if the disk becomes detached from the stem. Installed this way, there is no tendency for the flowing fluid to "pull" the disk from the stem when the valve is partly open.

Globe valves are designed primarily for throttling service and are superior to gate valves when used as such. They offer more resistance to flow than gate valves and may prevent complete drainage of the pipeline due to the valve construction. The globe valve is unbalanced, making it necessary to overcome full effect of fluid pressure against the disk area when closing or opening (depending on direction of flow).

University, La. G F Matthes

Keep Valve Under Control

Mef is right when he says that the answer depends on whether you want the valve closed or opened when the stem breaks or something else happens. The "something else" is the important thing. While it is not impossible for a stem to break, it is more sensible to consider the more common possibility of the disk coming off the stem. When the disk comes off, as shown in the sketch, the valve will close and stay that way if flow is from

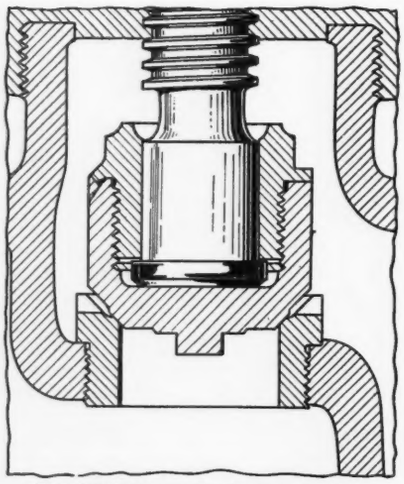


above the disk. The valve can't be opened except by backflow or by removing the bonnet and is thus uncontrollable.

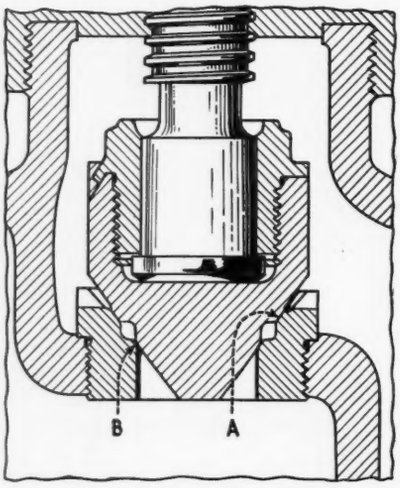
With flow from beneath, if the disk comes off the stem, the valve will remain open if the valve wheel is in that position. The valve can be closed in the normal

manner and usually can be controlled for a number of operations as long as pressure from beneath the disk holds it in position. For this reason, many valve makers stamp or cast an arrow on the body to point the recommended direction of flow. While it may be debatable, I feel that there is no installation where the valve should be used in a way to make it uncontrollable in case the disk comes off the stem.

Canton, Mass. H M SPRING



CONVENTIONAL TYPE SEAT AND DISK



THROTTLING TYPE SEAT AND DISK
A—Seating surface B—Point of Throttling

Check Valve Construction

IT IS QUITE COMMON to think of globe valves as installed with pressure below the disk, in fact most makers cast an arrow on the body indicating this direction of flow. Installation with pressure below allows repacking in the closed position as well as the wide-open position, with pressure on the line. The ASME Boiler Code specifies that feedwater valves be installed this way, so that they will not act as checks, preventing feed from entering the boiler should the disk become disconnected. This may be a good reason for putting the pressure below the disk in other cases where the check-valve action after a disk-stem failure might be objectionable.

But there are many places where the pressure should be taken above the disk. In large valves, particularly where high-pressure differentials exist, installation with pressure above the disk permits tight seating without use of wrenches, bars or gearing. Valves in open-end steam lines should be installed with pressure above the disk to keep the stem warm, prevent contraction and consequent leakage. Such leakage not only wastes steam but causes wire-drawing between seat and disk if the valve is not tightened after it has cooled off.

In systems handling corrosive fluids, the fluid often attacks the pipe and fittings only when oxygen is present. If globe valves are installed in a line where air can reach the valve when closed it is desirable to take the pressure above the disk to prevent severe corrosion of stem threads. Cases are encountered where the stem thread is eaten away, often the entire stem, because the valve was installed with pressure below the disk.

In some designs of throttling valves (see sketch) pressure should be taken above the disk. The sketch shows a narrow-seated throttling valve in which the disk is fitted with a conical projection which extends down into the seat-ring port. Throttling occurs at *B* and not at the seating surfaces. If pressure were taken below the disk, the high velocity produced by the restricted area at *B* would cause the fluid to impinge on the seating surfaces, causing severe erosion. By taking pressure above the disk, high velocity occurs after the fluid passes the seating surfaces, reducing wear at this point to a minimum.

Cincinnati, Ohio S E HESS

No Hard-and-Fast Rule

IT IS DOUBTFUL if the disk of a valve would seat properly if the stem broke, unless it is a guided disk valve, so I think other things must be considered. Globe valves operated by a number of persons, such as hot and cold water valves in a laundry, should be installed with pressure above the disk, to insure tight closing, as other employees may not be as economy-minded as an engineer. All steam valves should, as a rule, be installed with pressure below the disk to save packing from erosion, to allow the disk to absorb the cutting action of the fluid stream and to facilitate packing.

A boiler-blowoff angle valve should be installed with pressure above the disk as (assuming disk and seat to be in good condition), the pressure will hold the disk tight in case the other valve or cock should leak, thus preventing slow draining of the boiler.

I don't think there is any hard-and-fast rule to follow; an engineer must use his judgment.

Milwaukee, Wis. L M LARSON

Specific Suggestions

SERIOUS THOUGHT and good judgment should be used when installing either globe or angle valves. For example: boiler-feedwater valves placed between boilers and check valves, with pressure on both sides, should be installed so as to open with flow towards the boiler. Placing a pump-discharge valve so that pressure is above the disk may damage the pump and cause a shutdown if the disk comes loose from the stem.

Suction valves for pumps and compressors, throttle and exhaust valves for engines, pumps and turbines, boiler and water-column blowoff valves should all be installed to open with the flow. The same thing is true for oil circulating lines fitted with globe or angle valves, and for radiator valves. In cases where reverse flows occur, stop cocks can be used and an indicator will show if valve is open or closed, in case stem should break.

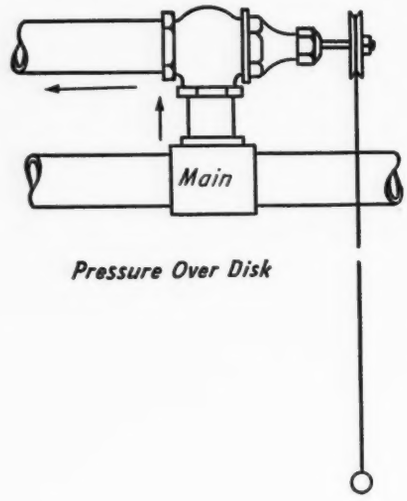
Many people believe the object of installing a valve with pressure under the disk is to permit packing when closed, but most valves today can be packed when either full open or closed.

Wauwatosa, Wis. W J HANSEN

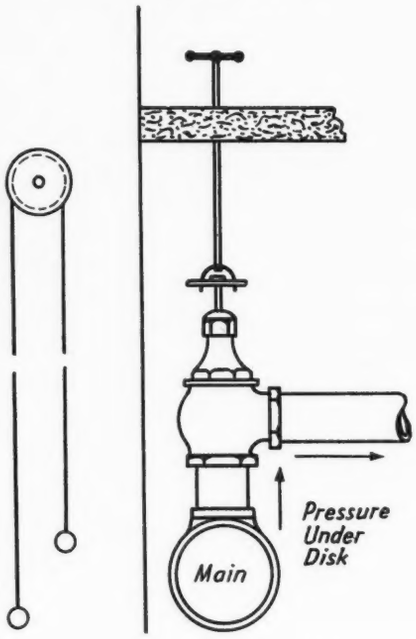
Consider Location

DIRECTION OF FLOW through globe valves is often determined by location. As shown in the sketch, use of extension handles or

(Continued on page 162)



Pressure Over Disk



HEADWORK SECTION

The necessary foundation for an understanding of power machines is a clear mental picture of the meaning of Force, Work, Energy, Power, Efficiency. Here is an A-B-C explanation of the first three

By PHIL SWAIN

FORCE is a *push* or a *pull*, generally measured in pounds. In Fig. 1, weight *A* pulls *down* on the rope with a force of 2 lb. The rope pulls *up* on the weight with a force of 2 lb.

WORK—A force acting on a moving body does work unless the force is at right angles to the direction of motion. If the force acts in the line of motion, the work done equals the force times the distance moved. If the force is measured in *pounds* and the distance in *feet*, the work comes out in *foot-pounds*.

Thus, in Fig. 2, the work done in raising the 2-lb weight vertically from *A* to *B*, a distance of 3 ft, is $2 \times 3 = 6$ ft-lb. If the weight is then lowered back to its original position, the weight does 6 ft-lb of work on the rope, and, through it, on any attached devices.

WORK WITH FORCE AT AN ANGLE—It often happens that the force does not act in line with the motion. Then, in figuring the work, use only that component of the force that is in line with the motion, or that component of the motion that is in line with the force (either, but not both).

The simplest case is where the force acts perpendicular to the motion, for example (Fig. 3) where a block slides on a horizontal frictionless surface. The surface pushes straight up on the block, but this force (equal to the weight of the block) does no work, because the force is perpendicular to the motion. The same applies to a weight whirling around at the end of a string. The pull of the string does no work because it is perpendicular to the motion of the ball.

Now look at Fig. 4, a ball pushed up a frictionless inclined plane from *A* to *B*. Since gravity acts straight up and down, figure the work done from the weight (4 lb) and the *vertical* movement of the ball (3 ft). Thus, the work is $3 \times 4 = 12$ ft-lb, just as if the ball were lifted vertically 3 ft. If you re-figured this problem using the actual slant distance moved and the force required to pull the ball up the slant, you would get the same answer.

ENERGY is the capacity for doing work and is often measured in work units. Fig. 5 shows a 5-lb weight held at rest 6 ft above the floor. It took $5 \times 6 = 30$ ft-lb to lift it there. If you should lower it gradually, the weight would do 30 ft-lb of work on the rope. If you dropped it freely, it would do 30 ft-lb of work on the floor. It therefore has an "energy," or work capacity, of 30 ft-lb, called *potential energy*.

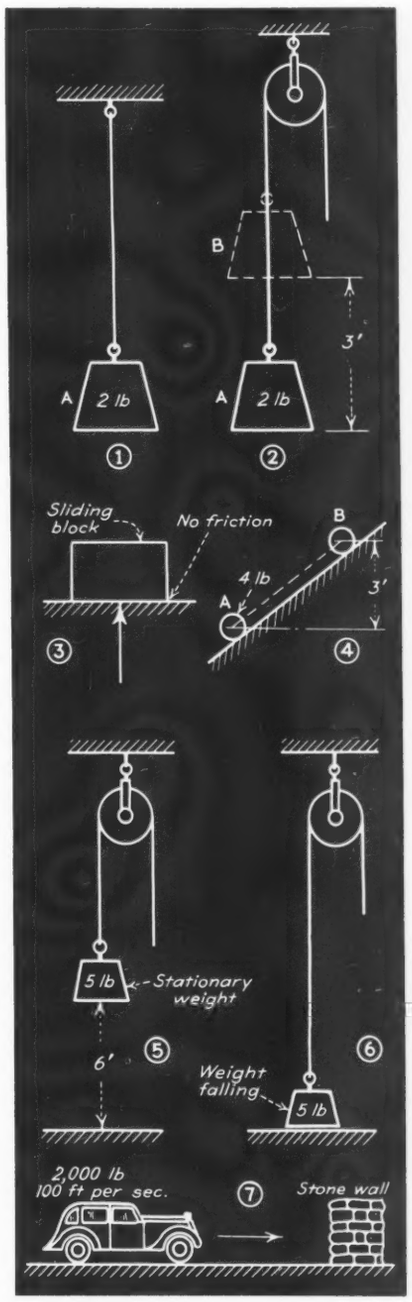
Now suppose we let the weight drop free and consider the situation just before it hits the floor (say 1/1000 in. above the floor). It no longer has potential energy (energy of position), but it is moving and therefore still has energy, because a weight in motion will do work on anything that stops it. This energy of motion, called *kinetic energy*, is here exactly 30 ft-lb. While the weight was falling, it was constantly losing potential and gaining an equal amount of kinetic energy. At every point in the fall, the two always add up to 30 ft-lb. Just before the weight hits the floor, it has 30 ft-lb of kinetic and no potential energy. Then the weight hits and converts this kinetic energy into 30 ft-lb of mechanical work.

Here is the formula for the kinetic energy of a moving body: *Kinetic energy* (in ft-lb) equals *mass of body* (in lb) times the *square of its speed* (measure in ft per sec) divided by *64*. For example, Fig. 7, a 2000-lb automobile is traveling at a speed of 100 ft per sec. What is its kinetic energy? Answer: $2000 \times 100 \times 100 \div 64 = 312{,}000$ ft-lb.

Other energy forms include heat energy, electric energy, chemical energy.

Any form of work or energy can be turned into any other form, but not always completely. Wherever friction or electrical resistance acts, some of the transformed energy goes into heat. Thus, a generator turns most of the work supplied into electrical energy, but some (called a loss) into heat.

The important thing to remember in any energy transformation is that energy is never destroyed, although it may not be useful for the desired purpose.



1—Weight pulls 2 lb on rope. Rope pulls 2 lb on weight. 2—Work to raise weight from *A* to *B* is 6 ft-lb. 3—Upward force on sliding block does no work. 4—Work to roll weight from *A* to *B* is 12 ft-lb. 5—Potential energy of weight is 30 ft-lb. 6—Kinetic energy of weight is 30 ft-lb. 7—Kinetic energy is 312,000 ft-lb

SHORT QUESTIONS ? QUICK ANSWERS

Fuels and Combustion

Q—What type of fuel is best adapted to the chain- or traveling-grate stoker?

A—Non-coking or free-burning coal. Typical Illinois bituminous and Pennsylvania anthracite are good examples.

Q—What type of fuel is best adapted to the underfeed stoker?

A—Coking coals such as West Virginia and Pennsylvania bituminous and many other eastern coals.

Q—What are the four essentials of perfect combustion?

A—(1) Proper temperature for ignition, (2) a furnace of proper volume, (3) an adequate supply of air, and (4) turbulence for thorough mixing of combustion products.

Q—What products come from the stack when coal burns under theoretically perfect conditions?

A—Carbon dioxide (CO_2), water (H_2O), nitrogen (N_2), and sulphur dioxide (SO_2).

Q—What is a "coking" coal?

A—Coals which fuse at the surface when burning, to form a more or less heavy crust, are known as "caking" coals. The term "coking" is often loosely used for such coals.

Q—What is a free-burning coal?

A—A free-burning coal does not form a crust and is friable throughout the combustion process.

Q—What amount of air is theoretically required to burn 14,000-Btu-per-lb coal?

A—Approximately 11 to 12 lb of air or about 144 to 157 cu ft at 62 F.

Q—Name three conditions which might cause incomplete combustion in a boiler furnace? What signs point to incomplete combustion?

A—(1) Excess air, (2) insufficient air, (3) improper mixing of fuel and air. If flue gas runs low in CO_2 and CO is present, incomplete combustion is indicated.

Q—What do you have to allow for in designing a smoke flue that doesn't enter the design of a fresh-air duct?

A—Expansion and contraction due to higher gas temperature.

Q—How do size of coal and thickness of fuel bed affect draft requirements?

A—Fine coal requires more draft than coarse; thick fuel beds require more draft than thin ones.

Q—In speaking of fuel oils, what is meant by (a) flash point, (b) fire point, (c) viscosity, and (d) Baumé gravity?

A—*Flash point* is the temperature at which volatiles will ignite momentarily at the surface, on the passing of a small flame, but combustion will not be supported. *Fire point* is the temperature at which combustion at the surface will be supported when a small flame causes ignition, and the vapor driven off will burn with a continuous flame. *Viscosity* is the internal resistance of a fluid to flow. *Baumé gravity* is an arbitrary measure of the density or specific gravity of oil, based on a hydrometer scale on which water has a value of 10.

Q—Write the chemical equation and figure the weight of products of combustion for complete combustion of carbon.

A—The chemical equation for complete combustion of carbon is:

$$C + 2\,0 = CO_2$$

Since 2.667 lb of oxygen is required to burn 1 lb of carbon, and 4.32 lb of air are required to provide 1 lb of oxygen, we have:

$$4.32 \times 2.667 = 11.52 \text{ lb of gas}$$

This weight of gas adds to the weight of carbon to give a total of 12.52 lb products of combustion.

Q—Write the chemical equation and figure the weight of products for incomplete combustion of carbon.

A—The chemical equation for incomplete combustion of carbon is:

$$C + O = CO$$

This time only 1.333 lb of oxygen are required per lb of carbon, while the amount of air per lb of oxygen stays the same: $4.32 \times 1.333 = 5.76$ lb of gas. Adding the 1 lb of carbon, we get 6.76 lb as the weight of the products.

Q—Mention 4 types of stacks having different operating characteristics.

A—(1) A stack of sufficient height may produce all draft required, (2) a shorter stack may be used in a plant where forced-draft fans handle the air through the fuel beds so that all the stack has to do is handle the products of combustion, overcoming resistance of boiler passages and breechings, (3) still shorter stacks may be used in plants equipped with induced-draft fans in addition to forced-draft units; the induced-draft fan overcomes boiler resistance and delivers gas to the base of the stack, (4) sometimes extremely short, venturi-shaped stacks with induced-draft fans in the base are used.

Q—What limits amount of forced-draft applied?

A—The capacity of the induced- or natural-draft system to take away the products of combustion.

ARGUMENT CORNER

Compressed Air Can Be Used Safely

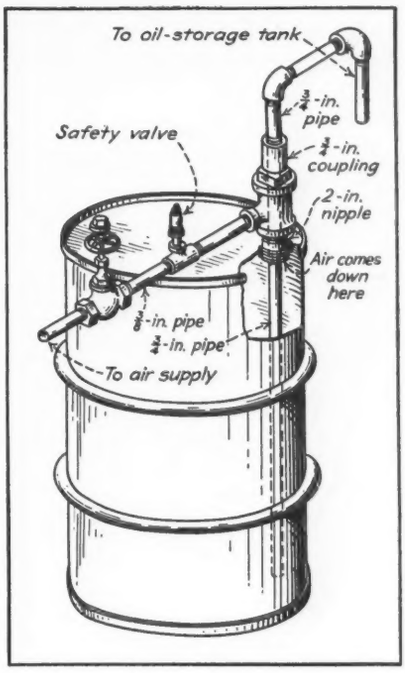
GEORGE EDWARDS' full-page blast, "Don't Use Compressed Air to Empty Barrels and Drums," leaves me wondering why he did not use the space to tell how the job could be done safely. If we follow the principles laid down in his article, we would not store compressed air in receivers because they blow up once in a while when proper precautions have not been taken.

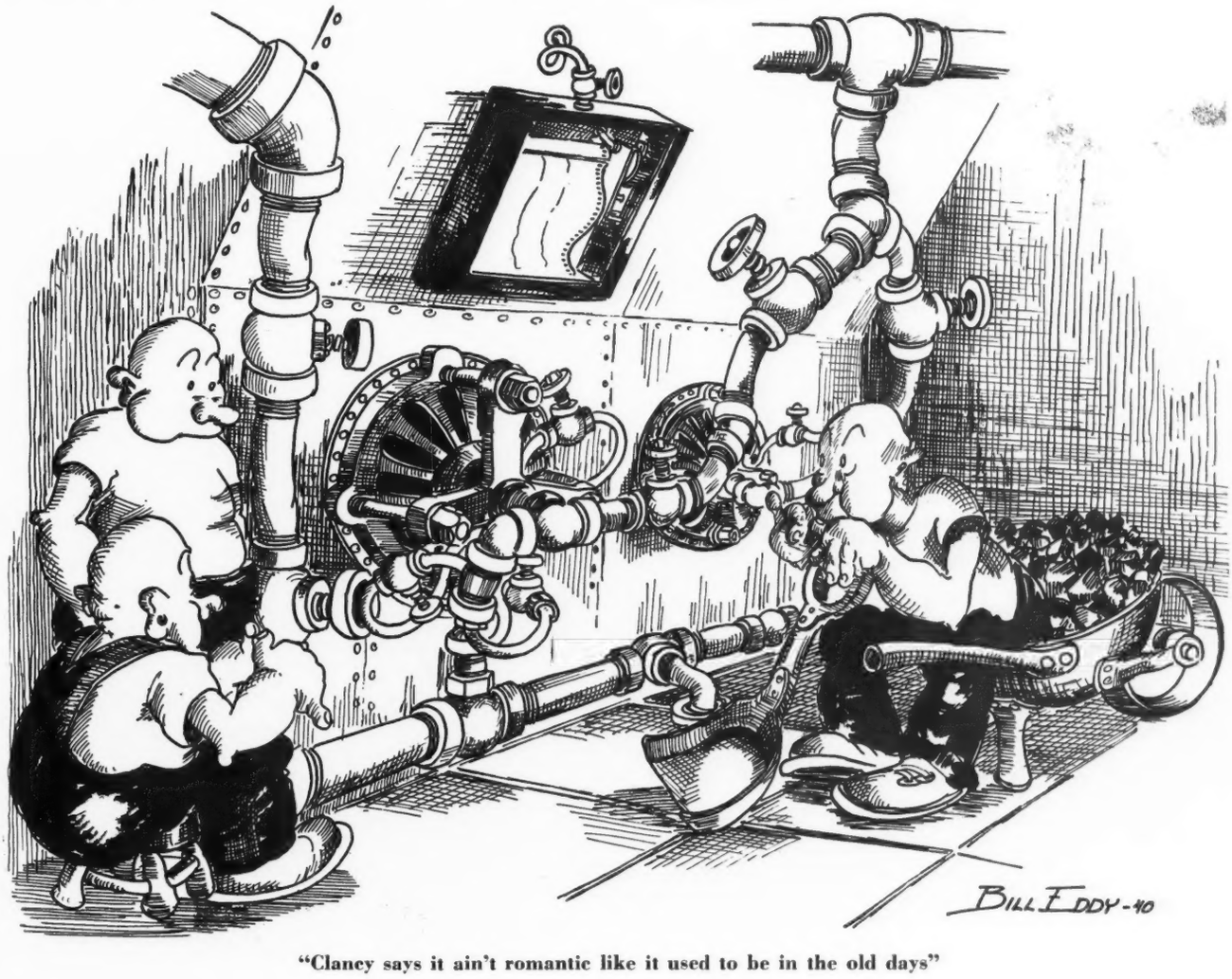
Boilers blow up when safe operating practices are neglected. Simply because these things happen is no reason to stop using them. When they are properly operated they are practically 100% safe.

I use compressed air to empty oil drums through a fitting, shown in the drawing, and feel that the practice is perfectly safe. This fitting is made from a 2x2x⅜-in. pipe tee with a 2-in. nipple in one end to screw into the oil-drum head. In the other end of the tee a plug is tapped and threaded for a ¾-in. pipe. This pipe is made long enough to reach nearly to the bottom of the oil drum. On its top end the pipe is threaded far enough through the plug to permit putting on a ¾-in. coupling for the oil-pipe connection to the storage tank.

Into the ⅜-in. connection on the tee the air connection is made. When the valve is opened air flows in on top of the oil, around the outside of the ¾-in. pipe to force the oil out. Do not permit the air pressure in the drum to exceed 5 to 8 lb per sq in., which is plenty to give a good oil flow. On my equipment the safety valve is set to blow at 7 lb.

Aurora, Colo. E J DUFF





"Clancy says it ain't romantic like it used to be in the old days"

HOW TO TEST FOR CHLORIDES

By C A NOLL
Chief Chemist
W H and L D Betz
(*Photos by* POWER)

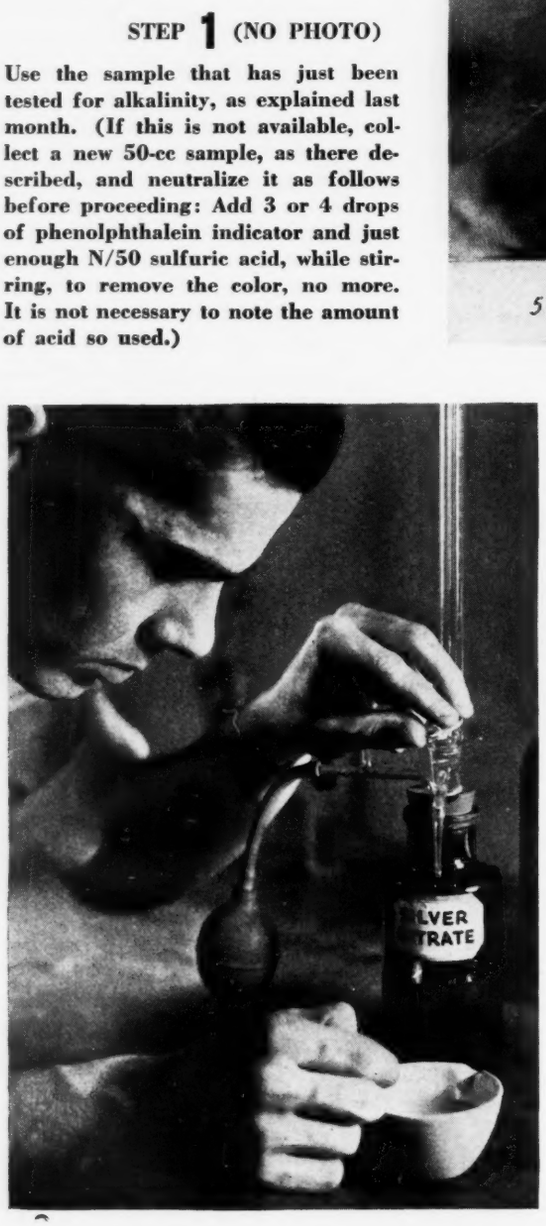
In February this "How To" section described a simple water-test kit. March showed how to test for hardness and April for alkalinity. This chlorides test will be followed by a final article on how to test for phosphates

STEP 1 (NO PHOTO)

Use the sample that has just been tested for alkalinity, as explained last month. (If this is not available, collect a new 50-cc sample, as there described, and neutralize it as follows before proceeding: Add 3 or 4 drops of phenolphthalein indicator and just enough N/50 sulfuric acid, while stirring, to remove the color, no more. It is not necessary to note the amount of acid so used.)

2

Add 5 drops of potassium-chromate indicator. This will turn the solution bright yellow



3

Slowly add silver nitrate solution (strength, 1 cc equals 1 milligram of chlorine), stirring constantly, until one final drop changes the color to pink. Keep stirring. If the pink goes back to yellow, add another drop. Stop when the pink just slides over into a permanent red

CALCULATION

Subtract 0.2 cc from the total silver nitrate used. Multiply remainder by 20 to get the ppm (parts per million) of chlorides present.

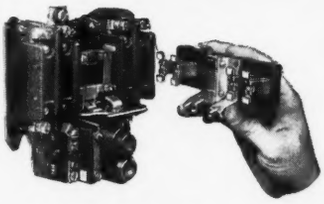
Example: Total silver nitrate solution used = 4.6 cc
−0.2
Net silver nitrate 4.4 cc
4.4 × 20 = 88 ppm of chlorides

Note: Where water to be tested is very brackish, a stronger solution of silver nitrate should be used, for which the chemist can supply the correct factor to convert cc used into ppm.

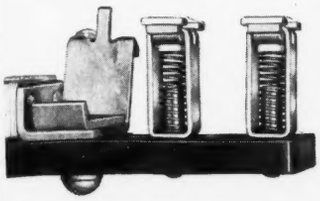
4

Record the amount of silver nitrate used, *minus 0.2 cc*. This completes the test, unless soluble sulphite (more than 10 ppm) is being maintained in the boiler to prevent corrosion. For that case a special technique, not here described, must be used

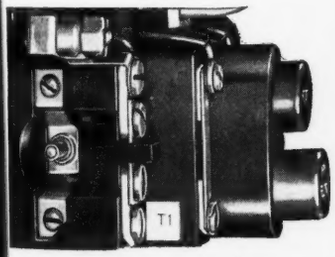
Some of the outstanding features of the New C-H NEMA Size 1 Starter



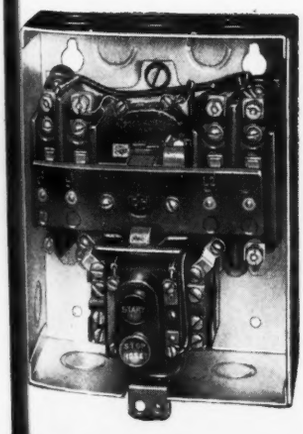
Vertical Dust-Safe Contacts Dust can't settle on vertical contacts. Vertical contacts mean better motor control. C-H vertical, dust-safe contacts are out in the open, cool, accessible, *safe.*



The pure "fine" silver contacts have been made much heavier, to establish *new* records for trouble-free performance under the most severe service. Lava insulators protect contact springs against even minor heat transmission, thus insuring full contact pressure at all times . . . an instantly accepted feature of good engineering which greatly extends the life of these working parts. Both contact springs and contact supports are now made of stainless steel . . . a feature widely accepted, but appreciated most where corrosive atmosphere is a problem.



The famed C-H "Drop of Solder" overload relay has been further refined. New *enclosed* heater coil construction . . . and new solder-alloy assembly easily and quickly removed for inspection. When an overload occurs, you don't have to guess why the motor has stopped. The red button pops forward, telling you at once. Overload relay is free-tripping.



The use of new Densheath internal wiring makes the Size 1 Starter exceptionally workmanlike in appearance. From the handsome cover, streamlined and simplified in the best modern design, to the beautifully finished light interior, advanced design is used throughout. Case has solid back. Mechanism is rubber mounted on a dead-back panel.

Cutler-Hammer Scores Again

A New Size 1 Starter

for motors up to 5 h.p.

A great switch principle has been improved, and a great new Size 1 Starter has been brought out by Cutler-Hammer for the control and protection of single phase motors and polyphase squirrel cage motors up to 5 h.p.

The basic design of this new starter is the design that has been pronounced repeatedly an outstanding example of masterful engineering. It has proven its correctness during 10 years of sales leadership . . . 10 years during which time it has withstood, successfully, repeated redesigns, by others, in an effort to meet C-H- standards.

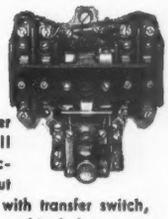
In this new Size 1 Starter, the *proven* C-H design has not been changed . . . simply *refined* . . . and *improved* . . . to set still higher standards of performance. Seasoned and practical men recognize the worth of these refinements at once. Make sure you see this new starter immediately. Cutler-Hammer Representatives will be glad to demonstrate its advantages to you. CUTLER-HAMMER, Inc., *Pioneer Electrical Manufacturers,* 1358 St. Paul Ave., Milwaukee, Wis.

CUTLER-HAMMER
MOTOR CONTROL
C-H

THE NEW C-H 9586 NEMA SIZE 1

Price $16.00*

***With Start and Stop buttons in case as illustrated, price $18.00**

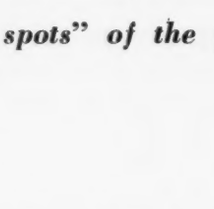


The new C-H Starter is available in all standard constructions, with or without pushbuttons in case, with transfer switch, in combination starter, and in skeleton construction for built-in application.

Those Hospital Plants Still Need a Doctor!

C T Baker, Atlanta consultant, adds fuel to Editor Swain's fire by giving the low-down on three hospitals where bad planning, poor operation, and penny-pinching management made "fever spots" of the power plants

▶ When Phil Swain said "Hospital Power Plants Need a Doctor" (Power, Dec, 1939) he was speaking in general, but actual cases from my experience back him up 100%. The "Four Horsemen"—bad design, poor operation, lack of maintenance, and penny-pinching management—make many hospital plants stand out in sorry contrast to their highly efficient medical and



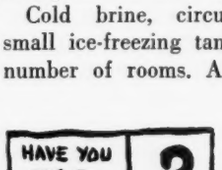
Four horsemen plague hospital power plants

surgical departments. Take these three cases for example:

A city of 20,000 felt really proud of its modern hospital, made possible by a large donation from a public-spirited citizen. The donor also made available the returns from securities, believed to be sufficient to take care of unusual operating costs which could not be paid for conveniently out of operating revenue. For a few years this did the trick, but with the depression the securities dropped in value and the returns diminished. With operating expenses high and on the increase, an investigation was made to see whether anything could be done to cut costs, the principal items of which were electric power, water and fuel.

The combined ice and refrigerating plant, installed when the buildings were erected, turned out to be the chief offender. When first put in service it had done its work well, but as time went on, troubles developed which not only reduced capacity but caused serious interruptions of service.

Cold brine, circulated from the small ice-freezing tank, refrigerated a number of rooms. After a few years



Must be another one of those census questions

operation, the brine mains developed serious leaks. This wouldn't have been so bad if an optimistic designer hadn't nonchalantly arranged for these lines to be sealed in the building walls. There was no solution but a shutdown until the walls could be opened and the defective pipe repaired.

Shortly after this, the brine pump gave trouble, and the compressor, automatically controlled, seldom cut out since it took almost continuous operation to hold temperatures. Examination of the motor-driven brine pump disclosed that the impeller and shaft were so badly eaten away that the only answer was to renew each. A pH check of the brine furnished the tip-off. Several tests showed brine pH of 5.5, decidedly acid. The engineer, who never heard of pH, had never tested the brine, so the condition had probably existed for years.

The brine was so full of dirt and trash that it was discarded and new brine substituted. Likewise, arrangements were made to check and treat the brine at regular intervals. A careful study of the brine system revealed one of the causes of acid brine; failure to submerge the end of the brine-return main permitted the brine stream to pick up air in its 8-in. descent from the open end of the return pipe to the brine level in the tank. Needless to say, the acid brine had eaten away the zinc coating on the ice cans, which were so badly rusted as to call for almost complete replacement.

The compressor was in deplorable condition. To put the machine in first-class shape meant a whole set of rings for each of the two cylinders, and new suction and discharge valves. As no one had opened the compressor since installation, there was no way to tell how long it had been in bad shape or how much unnecessary power had been consumed because of piston and valve leakage. Difficulty in getting approval to buy even a 100-lb drum of ammonia kept the charge low and added to compressor running time.

High condensing pressures gave some idea of what the double-pipe ammonia condensers would look like when

Plant started with 2 strikes on it

opened up, but there was even more dirt and sludge than expected. The fact that it was never possible to scrape these tubes because the condensers were between two walls with 18-in. clearance at one end and 24-in. clearance at the other, may have had something to do

(Continued on page 114)

Suitable for ALL PRESSURES *without change of valve or seat*

Small size . . . Hardly larger than a pipe union . . . a fraction of the size of ordinary traps. ½-inch trap measures 2¼ inches; 2-inch trap, 4¾ inches long.

Light weight . . . Requires no support other than the pipe line, eliminating the bother and cost of complicated brackets and other structures. ½-inch trap weighs only 1⅛ lbs., 2-inch trap weighs 8½ lbs.

Low cost . . . It is frequently cheaper to install a new Yarway trap than to try to repair an old, worn, ordinary trap.

Easily installed . . . Straight line piping, together with small size and light weight of trap, simplifies the installation, makes a neater, better-looking job and leaves clear space around equipment.

High efficiency . . . Faster heating and greater sustained heating efficiency, because this trap opens wide, discharging large amounts of air and condensate quickly at the start and continuously thereafter. Small size reduces radiation loss to a negligible minimum.

Less maintenance . . . Rugged bar-stock construction throughout. Only one moving part—a simple valve "F". Valve and seat of stainless steel, heat-treated for long life and severe service; body and bonnet of cold drawn steel, bright cadmium plated inside and out for permanent rust-free finish; control cylinder of stainless steel; cap of tobin bronze.

Standardized . . . Six sizes, ½" to 2", serve practically all trap requirements without change of internal parts. Standard construction (described above), for pressures up to 400 lbs., stainless steel trimmed for pressures up to 600 lbs. *Same valve seat for all pressures without change.*

YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia

YARWAY

ANOTHER YEAR OF WIDESPREAD POPULARITY

IMPULSE STEAM TRAP

Those Hospital Plants Still Need a Doctor!

Continued from page 112

with this condition. Tube ends were almost eaten away and to renew them meant shutting down the plant and moving the condensers outside the building where there would be room to do the job. This the management refused to allow because it would "cost too much."

This plant started with two strikes on it because no provision was made for a cooling tower, which meant that city water was used and then allowed to overflow to the sewer. As condensing

City water caused triple trouble

pressure increased due to dirty condensers and air in the system, more and more city water went through the condensers until finally 50 gpm of city water went to the sewer day after day. It took exactly ten months to sell the management on the installation of a cooling tower which actually paid for itself in a few months on the water saving.

Another hospital plant I investigated presented no better picture, just a different set of troubles. This was a county institution, operated by a superintendent reporting directly to the county commissioners.

A battery of two boilers supplied heating-system steam while a third furnished steam for kitchen service, sterilization, and hot-water heating. Returns from the heating system were collected and fed back to the stoker-fired heating boilers and so little make-up was needed. However, the third boiler received cold water directly from the city mains because condensate from the piping system and from the water-heating tank went, for the most part, to the sewer. This meant triple trouble; loss of heat, cost of water, and the effect on the boiler of feeding cold water.

An even bigger waste occurred in uninsulated pipe mains and branches serving the heating system of the Nurses Home, a 2-story building about 100 ft from the main hospital. Steam supply went overhead to this building, with the mains and laterals supplying the two floors supported from ground-floor joists, approximately 3 ft above ground. The brick foundation, fitted with ventilators, permitted air circulation below the floor. Since the total square feet of steam mains and branches exposed in this space exceeded the total radiating surface in the building, it isn't hard to imagine the amount of heat lost.

Apparently the designers and builders forgot that people would have to work in the various parts of the building. Lack of proper ventilation in the kitchen and a steam cooker discharging hot-water and vapor from the jacket directly to the room caused noon-day temperatures to run 95–97 F while relative humidity rarely dropped below 85%.

Summer heat rendered operating rooms almost unbearable; temperature of the two rooms and the nurses' station between was found to be 95 F at 2:30 in the afternoon. Since it was necessary to keep the operating rooms tightly closed during use, much higher temperatures were registered. Temperature readings made on the concrete-slab roof (tar-paper finish) showed air temperature 5 ft above roof to be 96 F and temperature of the black roof surface to be 150 F, with a good breeze blowing and the sun occasionally disappearing behind a cloud.

A check showed that original specifications had not been followed. If they had, the roof slab would have been insulated with four thicknesses of roofing felt on top and a tar and gravel finish.

Ventilation Forgotten

In laying out the X-ray developing rooms, designers took extreme pains to exclude all light but forgot to provide ventilation so that temperature and humidity in the almost hermetically sealed room made working conditions unbearable.

The final report on this hospital outlined all the steps necessary to put this plant in order, including an insulated roof slab and air conditioning for the operating rooms. However, since all county commissioners were up for re-election, they were afraid to authorize 45% of the total cost even though the PWA was trying hard to give the county 55%. Some were re-elected and some not, but the hospital still goes on wasting money.

Still another hospital recently shut down and dismantled its ice-making and refrigeration plant because of high operating costs. Wanting to know why power costs were high enough to cause the management to abandon the original plant, I made a quiet investigation. It wasn't hard to find the reasons.

As originally installed, the plant consisted of one compressor, three stands of double-pipe condensers, brine and water circulating pumps, and the usual auxiliaries. A 150-gpm, 115-ft-head pump, requiring 15 hp to operate, supplied water for the ammonia condensers. Had the designers divided the condensers into six stands, six pipes high, and installed proper suction and discharge lines, a 60-ft-head pump would have done the job at about half the power consumption of the high-head pump. The same thing was true of the brine pump; better coil and piping layout would have reduced head and power needs.

Wise expenditure turns red ink to black

The "vintage of '76" ice tank got along without any brine agitation beyond that resulting from operation of the pump. Lack of adequate tank insulation caused excessive heat leakage. Coils were below the cans, with several coils connected in series and all arranged for the old-fashioned method of liquid supply, with liquid ammonia coming in at the top and being removed as gas at the bottom.

Since no one in the plant believed in periodic inspection, the compressor had not been opened for examination in several years and no one could remember what the inside of the condenser tubes looked like. Little wonder that operating costs were high!

Who's to blame? Well, many of the things wrong with these plants go back to the original design, and some trace back to poor operation and maintenance. But the solution for all of them lies in a changed attitude on the part of hospital managers. They must learn that penny-pinching on original layout, and subsequent maintenance, costs money rather than saves it, and that wise expenditure to correct past mistakes will turn red ink to black.

NEW YORK LIFE INSURES AGAINST POWER FAILURE

SIXTY FEET UNDERGROUND in the sub basement of the New York Life Insurance Building a Hays Automatic Combustion Control System operates two oil burning boilers at a constant steam pressure and at the highest rate of combustion efficiency. In the Chief Engineer's report on the operation of his improved plant appearing in the January issue of National Engineer he says "The oil units respond so quickly and are so flexible it is not necessary to forecast changes in the load. The HAYS COMBUSTION CONTROL causes the burners to follow and satisfy these changes as they occur."

Changes in the steam header pressure cause an immediate response in the control system which operates to automatically regulate the oil flow and air supply to bring the pressure back to normal. Air and fuel are measured so as to maintain the most efficient and economical combustion which is indicated on the panel board by the CO_2 recorders, draft gages and smoke alarm.

Hays Combustion Control Panel in the New York Life Building at 51 Madison Ave., New York.

New York Life Insurance Building

If desired automatic regulation may be cut off at any time and the boilers operated by hand from the panel through remote manual control. The Hays system is electrically operated by which reason there is practically no time lag between the necessity for correction and the corrections themselves.

Similarly in boiler rooms throughout the nation, Hays Automatic Combustion Control is lowering fuel costs and maintaining highest operating efficiency, in most cases paying its initial cost in a year or eighteen months of operation. Highly efficient engineer representatives are located in all large centers to work with power plant owners and operators in determining the necessity and cost of instrumentation and control. You are invited to use this service without obligation. Write to 905 Eighth Avenue for further information.

The HAYS CORPORATION

SINCE 1901 COMBUSTION INSTRUMENTS AND CONTROL

MICHIGAN CITY, INDIANA, U.S.A

How to Figure Additional Capacity for Refrigeration Condensers

By T L SCOPES

► ENGINEERS OF AMMONIA REFRIGERATION plants are frequently called on to add to condensing equipment to handle more capacity. When this involves double-pipe condensers, the job of selecting the right combination of pipe sizes and length can be simplified by using the data on over-all heat-transfer coefficients developed by Douglas and Westcott[1].

These two men examined a number of operating installations and found that, when ammonia vapor condenses between the pipes and the cooling water flows in the central pipe, the over-all heat-transfer coefficient changes with the water velocity according to two simple equations:

For water velocities up to 160 fpm:

$$K = 12\sqrt{V}$$

For water velocities between 160 and 300 fpm:

$$K = 28\sqrt[3]{V}$$

where K is the over-all heat-transfer coefficient (Btu per sq ft, per hour, per deg F) and V is water velocity (fpm). The value of K computed from these formulas applies to the outer surface of the inner (water) pipe.

The curve, computed from these two equations for the range from 30 to 300 fpm, greatly simplifies the work of figuring surface requirements. The following problem and its solution shows how to use the curve.

Problem:

An existing plant requires additional condensing capacity equivalent to 10 tons of refrigeration. The new unit will parallel existing condensers so as not to increase pressure drop. The high side pressure is 180 lb per sq in. and cooling water is available at 70 F. Load balance requires a water discharge temperature of 90 F. Existing condensers are built from 1¼-in. x 2-in. full-weight steel pipes.

Solution:

Neglect any pressure drop on the ammonia side. For further simplification, assume no radiation loss. The heat to be removed (Q) is

Q = 10 tons × 200 Btu per min per ton
Q = 2000 Btu per min
Q = 120,000 Btu per hr

Water required for cooling (W) equals the heat to be removed divided by the temperature rise times the specific heat of water, which is 1. Thus

$$W = \frac{2000}{(90-70)\times 1} = 100 \text{ lb per min, or } 12 \text{ gpm, approx.}$$

To find the velocity (V) through 1¼-in. FWS pipe, which has an internal dia of 1.38 in., we divide the water quantity by the internal area:

$$V = \frac{100}{62.4} \times \frac{144 \times 4}{\pi \times 1.38^2} = 154 \text{ fpm}$$

Now we go to the curve to find the over-all heat-transfer coefficient for 154 fpm, which is 149 Btu per hr per sq ft per deg F. Since the condensing temperature of ammonia at 180 lb g is 95 F, we find the mean temperature difference (t_m) between water and ammonia to be:

$$t_m = \frac{(95-70)+(95-90)}{2} = 15 \text{ F}$$

The heat-transfer surface (A) required will be found by dividing the heat to be removed by the transfer coefficient and the mean temperature difference:

$$A = \frac{120{,}000}{149 \times 15} = 53.7 \text{ sq ft.}$$

The heat transfer surface (external) of 1¼-in. FWS pipe is 0.435 sq ft per foot of length. This figure can be found in a handbook, or can be calculated readily. Thus the required length is:

$$\frac{53.7}{0.435} = 124 \text{ ft, approx.}$$

This length is based on clean pipe and clean water. To take care of fouling, and obtain a unit with good performance between cleaning operations, the new condenser should be designed with some safety factor. Naturally, this allowance varies from place to place, depending on the condition of the cooling water. For this problem, allow 25%: 124 × 1.25 = 155 ft.

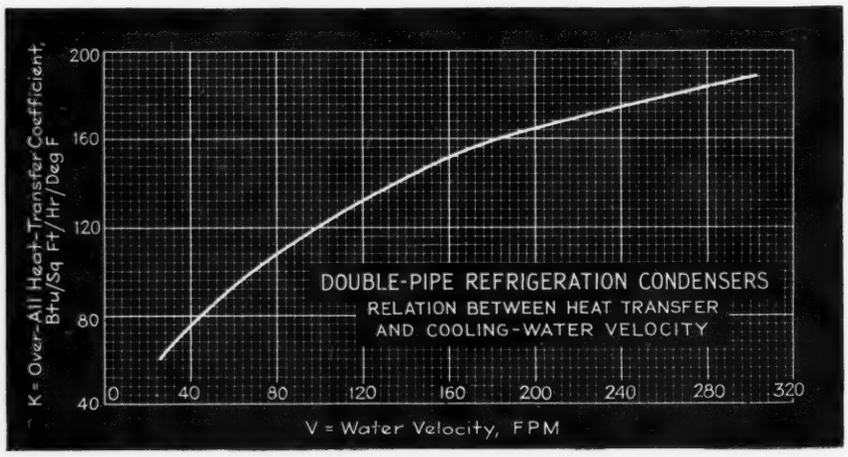
If standard 20-ft lengths are used, only about 18 ft will be effective, that is, water cooled. Hence the unit will have this number (N) of pipe lengths:

$$N = \frac{155}{18} = 8.6$$

Construct the unit with nine 20-ft lengths in one stand.

Water velocity to be used depends on plant conditions, freedom from silt, etc. Velocities of 120 to 200 fpm will give generally satisfactory results; 300 fpm should be considered the maximum desirable velocity.

Considerable latitude as to combination of piping sizes can be exercised. Existing equipment should, however, be duplicated where possible, to minimize the stock of spare parts required. Recommended piping size combinations, in inches, are: ¾ x 1¼, 1 x 2, 1¼ x 2, 1¼ x 2½, 1½ x 2½, 2 x 3. All piping should be full-weight steel.



[1] *Douglas and Westcott,* ENGINEERING, *August 26, 1932.*

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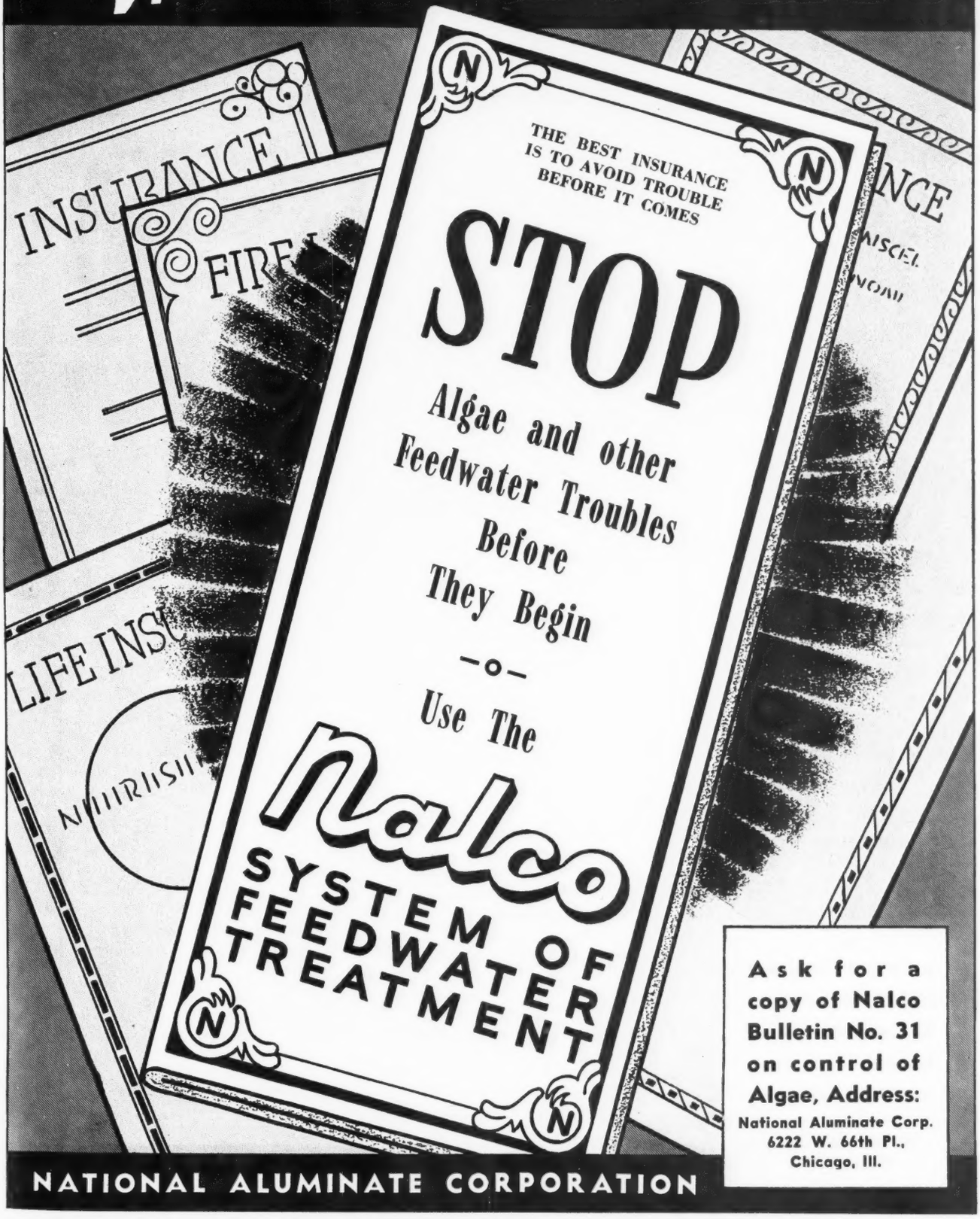

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Kraemer Firing System Makes Good Showing on Europe's Low-Grade Fuels

By MAX F A WULFINGHOFF

►THE GROWING POPULARITY of the Kraemer system for burning low-grade coals constitutes a major trend in European power practice. For many years, pulverized-coal systems of standard types had been employed in Central Europe, but in many cases it was felt that the cost of drying and milling outweighed the advantage of fuel flexibility.

This situation caused Kraemer, then chief engineer of a large power station, to cast about for a firing system that would retain the general advantages of pulverized-fuel firing without some of its disadvantages. In 1934 he brought out the system which bears his name and which has been widely used in recent years.

In this system, drying, grinding, and separating all take place in a simple vertical well; water vapor issuing from the fuel is not separated from the combustion gas; and fineness of grinding is limited to a point where gains in efficiency balance pulverizing cost.

The diagram shows the mill wells which are independent from the furnace proper and connected to it by a throat. In usual boiler sizes, two to four mills are provided. Up to a rated steaming capacity of about 90,000 lb per hr, two mills may be enough, as even when one mill shuts down, the other will keep the boiler going at 60–70% of nominal load.

Arrangement of Mills

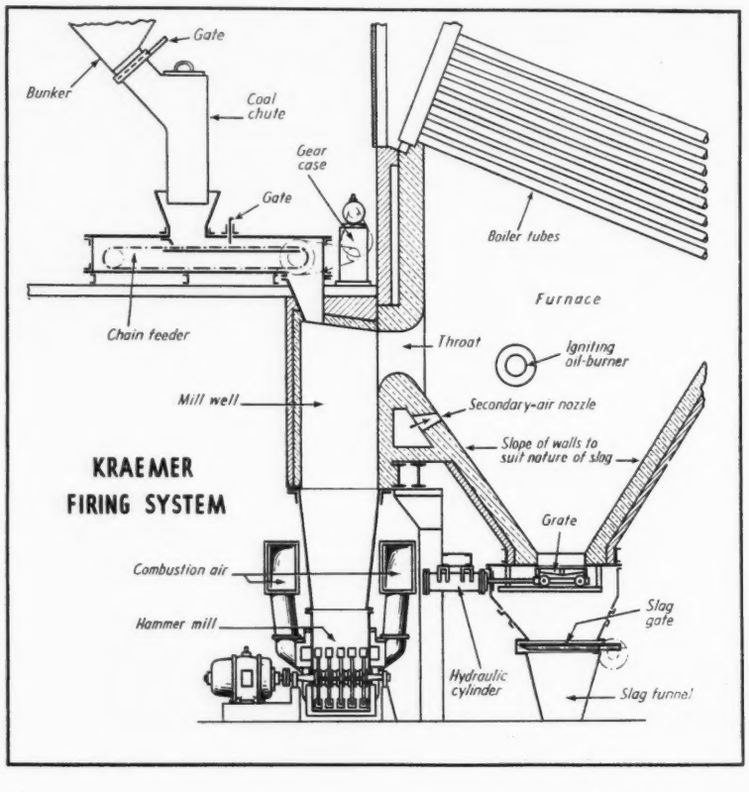
The mills, equipped with pivoted swing hammers, are arranged at the bottom of each well. Where the air heater is of adequate size and the fuel not too moist, no return of flue gas is required, part of the heat for drying being supplied by radiation from the furnace. If a flue-gas-return duct is needed, the hammer arms are shaped to provide the necessary blower action. A separate fan supplies combustion air.

Secondary air is admitted in the usual fashion; introducing cold secondary air from below the grate causes slag to granulate without help of a water-tube screen. As only primary air is preheated, air heaters need only be laid out for 60–80% of the total air volume.

Setting gate opening and adjusting gearbox speed of the chain feeder regulates fuel feed. The fuel falls into the mill well where it is ground and carried over into the furnace by the air and gas current. The amount of fuel entrained depends on the velocity. Thus, fineness is controlled by air supply, according to the nature of the fuel. High-volatile fuels are ground to comparatively coarse grains which are blown into the furnace where their weight forces them down to burn completely on a small sliding (see drawing) or tilting grate at the furnace bottom. Finer grains burn in suspension. Practically complete combustion results, the usual percentage of unburned combustible running less than 1%.

Mill housings are welded from steel plate and fitted with interchangeable wear linings. Refractory lines the upper part of the wells. The mill shafts are driven individually and mounted on dustproof roller bearings. The hammer arms carry 12%-manganese-steel heads. Cost of replacing hammers runs about 1.5 to 4.7 cents per ton of coal, and the useful life of hammers averages 1100–1800 hours. Power consumption varies between 7 and 12 kwhr per ton.

The Kraemer system can be readily installed in existing boiler houses as it is usually unnecessary to increase furnace dimensions. Results in European plants seem to prove it far more flexible than available stokers and traveling grates. It makes possible extremely wide choice of fuel and gives remarkable efficiencies even with high-moisture, low-grade fuels which cannot be burned with any reasonable efficiency in other firing appliances. The first cost of a Kraemer firing system runs about 15–20% higher than that of stokers. Very abrasive fuels, such as coals containing pyrites, may be expected to cause excessive wear and tear of hammer heads.



29 YEARS ON THE ROCK PILE!

Here's a True Story on What Happens When Lo-Maintenance Motors are Put on a Tough Job . . . Operating Rock Pulverizers . . . with Lime Dust Filling the Air! Read This Story of 29-Year Performance . . . the Kind of Money-Saving Service Allis-Chalmers Motors Offer You!

TURNING ROCK CRUSHERS . . . WITH ABRASIVE lime dust making operation difficult — these 50-hp Lo-Maintenance Motors have a fine record of going 29 years without running up high repair or maintenance expenses. And they are still giving daily service!

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That's exactly the problem at the Waukesha Lime & Stone Company, Waukesha, Wisconsin. The job is as hard as any you'd ask motors to perform. And to make things even worse — abrasive lime dust fills the air . . . seeps into the motors.

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Save Power Dollars with Lo-Maintenance Motors!

For when you buy Allis-Chalmers Lo-Maintenance Motors, you get motors that deliver more than just a rated horsepower. Into these motors are built the results of Allis-Chalmers 90 years of progressing with industry.

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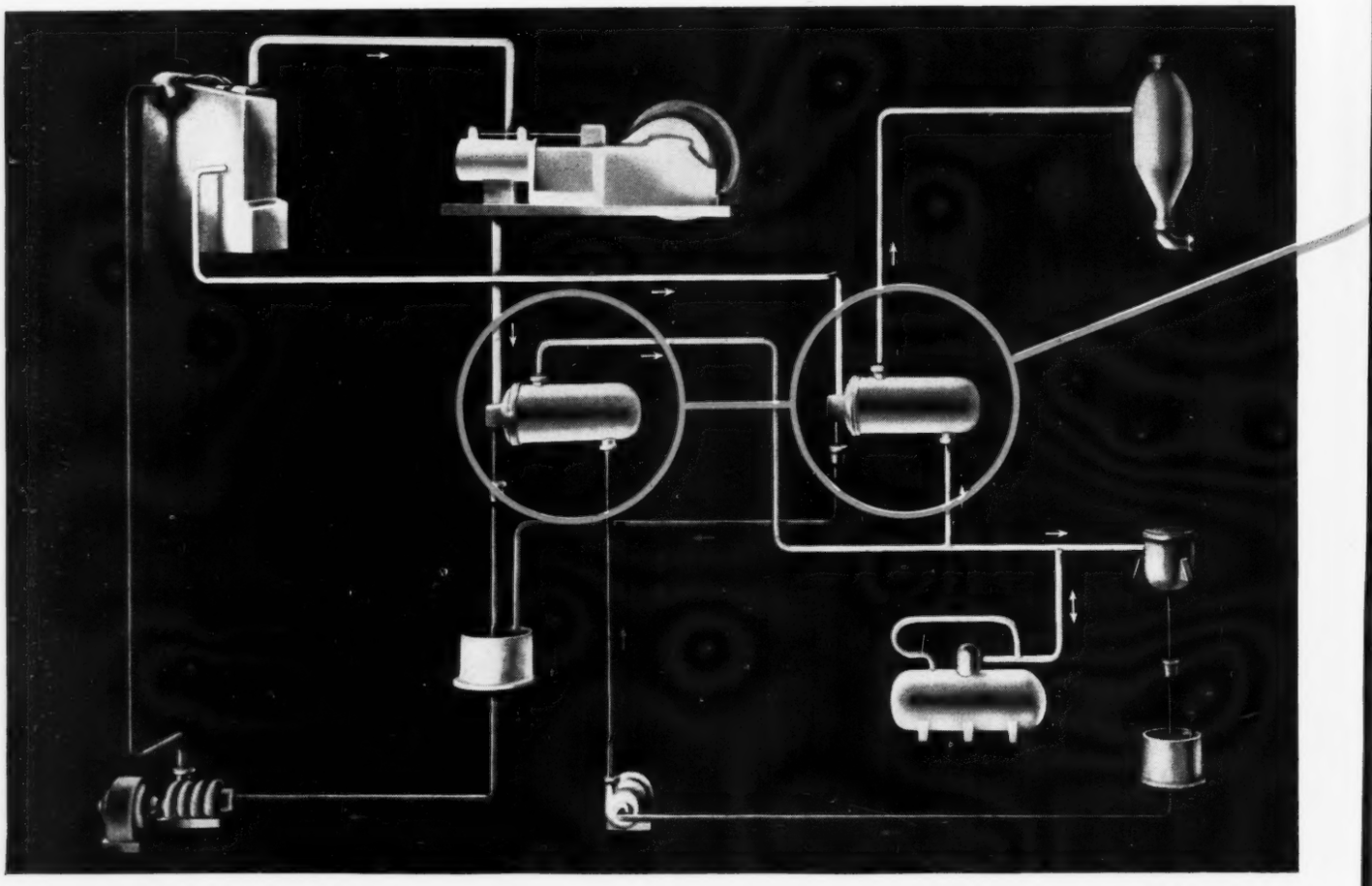
FOR EVAPORATOR CONNECTIONS . . .



Courtesy—Power Magazine

HOOKUP #18 **Ingenious use of evaporators or steam transformers results in closed boiler-water circuit in this high-pressure engine plant. Engine exhaust evaporates condensate returns and makeup, supplying 1-p process. In a second transformer, saturated steam taken from the boiler by a separate connection superheats steam for high-temperature process. Drains are trapped back to boiler circuit. Accumulator (actually old boilers, not fired) smooths out swinging process load.**

FOR THE PURPOSE of valve application, we show, at right, a typical diagram utilizing both an Evaporator and a Steam Transformer.

To permit operating the boiler with little makeup, superheated steam for process is made in a Steam Transformer (actually an Evaporator). Heat from boiler steam flowing inside coils evaporates raw water which may be preheated for economy.

Bleed steam supplied to Evaporator distills makeup and supplies steam for low pressure process.

Other superheated steam process units may be substituted for the Rotary Dryer—but here and elsewhere throughout the diagram, the principles of "Good Valve Practice" remain the same.

NEXT MONTH—DESUPERHEATER CONNECTIONS

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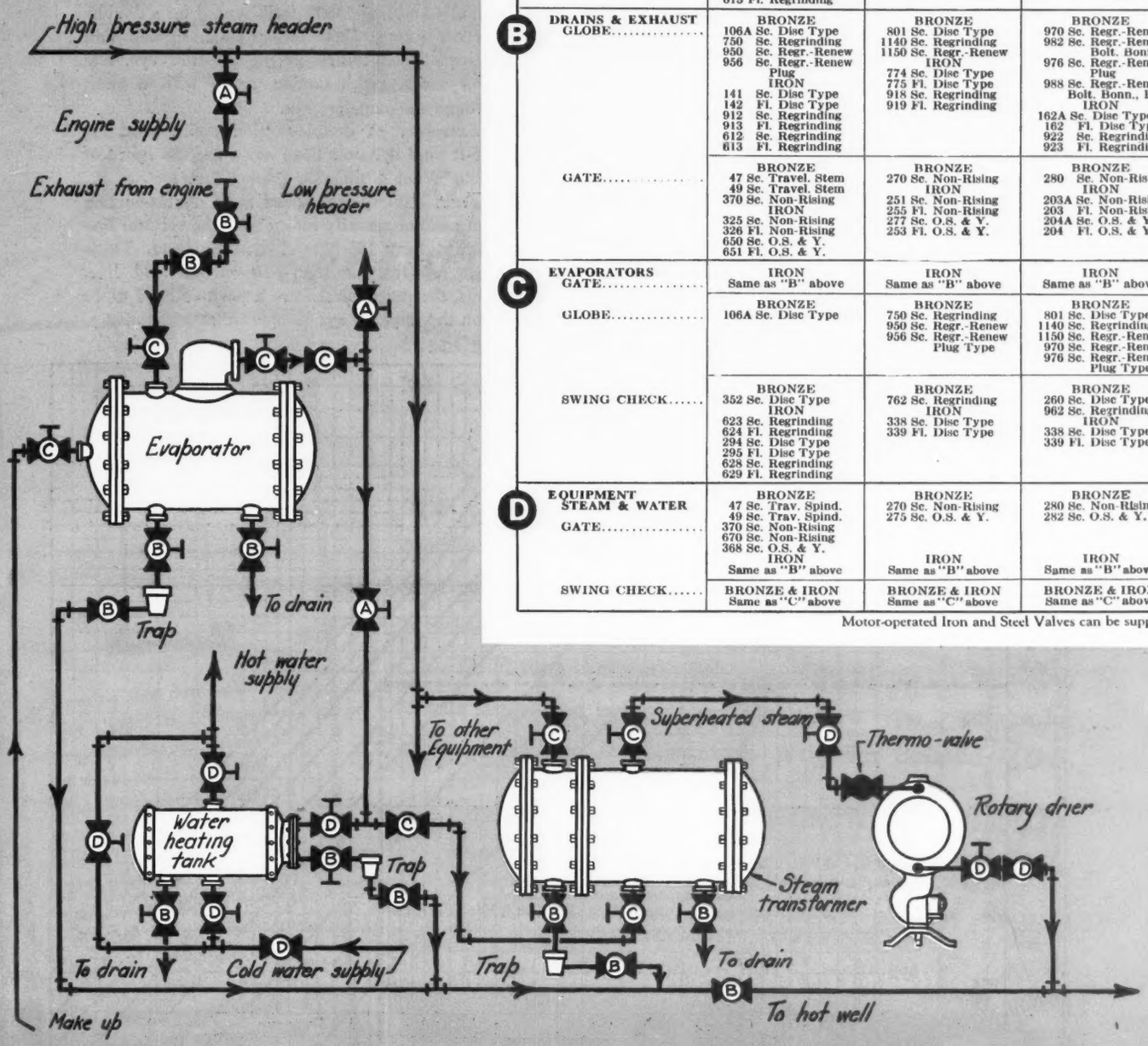
. . . TO *GOOD* VALVE PRACTICE

Jenkins RECOMMENDS . . .

STEAM AND WATER



REFERENCE CHART TO JENKINS FIGURE NUMBERS FOR EVAPORATOR CONNECTIONS

		Standard	Medium	Extra Heavy
A	STEAM SUPPLY GATE	IRON 651 Fl. O.S. & Y.	IRON 253 Fl. O.S. & Y.	IRON 204 Fl. O.S. & Y.
	GLOBE	IRON, 142 Fl. Disc Type 913 Fl. Regrinding 613 Fl. Regrinding	IRON 775 Fl. Disc Type 919 Fl. Regrinding	IRON 162 Fl. Disc Type 923 Fl. Regrinding
	ANGLE	IRON 144 Fl. Disc Type 915 Fl. Regrinding 615 Fl. Regrinding	IRON 777 Fl. Disc Type 921 Fl. Regrinding	IRON 163 Fl. Disc Type 925 Fl. Regrinding
B	DRAINS & EXHAUST GLOBE	BRONZE 106A Sc. Disc Type 750 Sc. Regrinding 950 Sc. Regr.-Renew 956 Sc. Regr.-Renew Plug IRON 141 Sc. Disc Type 142 Fl. Disc Type 912 Sc. Regrinding 913 Fl. Regrinding 612 Sc. Regrinding 613 Fl. Regrinding	BRONZE 801 Sc. Disc Type 1140 Sc. Regrinding 1150 Sc. Regr.-Renew IRON 774 Sc. Disc Type 775 Fl. Disc Type 918 Sc. Regrinding 919 Fl. Regrinding	BRONZE 970 Sc. Regr.-Renew 982 Sc. Regr.-Renew Bolt. Bonn. 976 Sc. Regr.-Renew Plug 988 Sc. Regr.-Renew Bolt. Bonn., Plug IRON 162A Sc. Disc Type 162 Fl. Disc Type 922 Sc. Regrinding 923 Fl. Regrinding
	GATE	BRONZE 47 Sc. Travel. Stem 49 Sc. Travel. Stem 370 Sc. Non-Rising IRON 325 Sc. Non-Rising 326 Fl. Non-Rising 650 Sc. O.S. & Y. 651 Fl. O.S. & Y.	BRONZE 270 Sc. Non-Rising IRON 251 Sc. Non-Rising 255 Fl. Non-Rising 277 Sc. O.S. & Y. 253 Fl. O.S. & Y.	BRONZE 280 Sc. Non-Rising IRON 203A Sc. Non-Rising 203 Fl. Non-Rising 204A Sc. O.S. & Y. 204 Fl. O.S. & Y.
C	EVAPORATORS GATE	IRON Same as "B" above	IRON Same as "B" above	IRON Same as "B" above
	GLOBE	BRONZE 106A Sc. Disc Type	BRONZE 750 Sc. Regrinding 950 Sc. Regr.-Renew 956 Sc. Regr.-Renew Plug Type	BRONZE 801 Sc. Disc Type 1140 Sc. Regrinding 1150 Sc. Regr.-Renew 970 Sc. Regr.-Renew 976 Sc. Regr.-Renew Plug Type
	SWING CHECK	BRONZE 352 Sc. Disc Type IRON 623 Sc. Regrinding 624 Fl. Regrinding 294 Sc. Disc Type 295 Fl. Disc Type 628 Sc. Regrinding 629 Fl. Regrinding	BRONZE 762 Sc. Regrinding IRON 338 Sc. Disc Type 339 Fl. Disc Type	BRONZE 260 Sc. Disc Type 962 Sc. Regrinding IRON 338 Sc. Disc Type 339 Fl. Disc Type
D	EQUIPMENT STEAM & WATER GATE	BRONZE 47 Sc. Trav. Spind. 49 Sc. Trav. Spind. 370 Sc. Non-Rising 670 Sc. Non-Rising 368 Sc. O.S. & Y. IRON Same as "B" above	BRONZE 270 Sc. Non-Rising 275 Sc. O.S. & Y. IRON Same as "B" above	BRONZE 280 Sc. Non-Rising 282 Sc. O.S. & Y. IRON Same as "B" above
	SWING CHECK	BRONZE & IRON Same as "C" above	BRONZE & IRON Same as "C" above	BRONZE & IRON Same as "C" above

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Number 94

Centrifugal-Pump Specific Speed

SPECIFIC SPEED of a centrifugal pump, expressed by the formula:

$$N_s = \frac{RPM \sqrt{GPM}}{H^{\frac{3}{4}}}$$

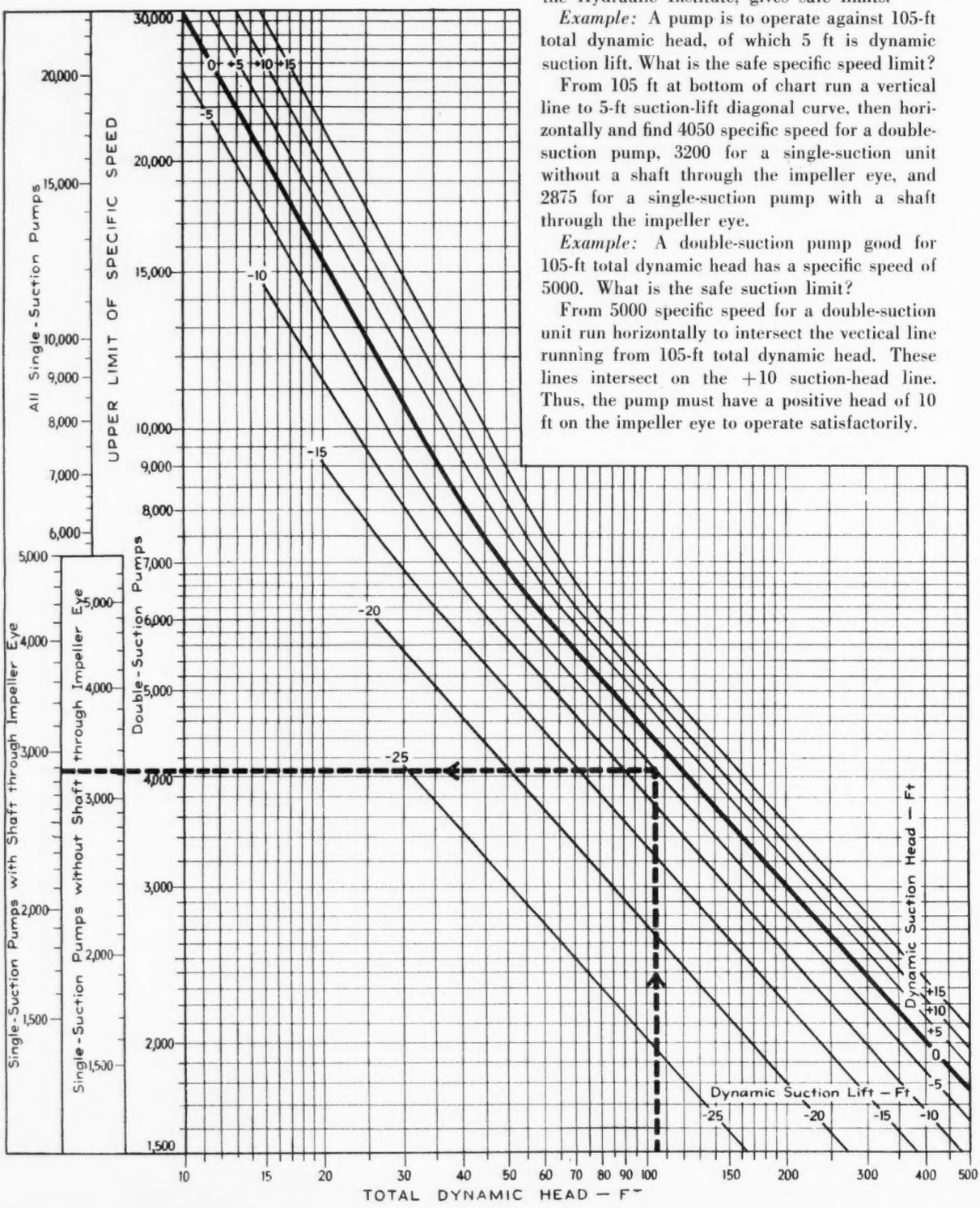
is an important factor in determining the maximum suction lift against which the pump can operate without trouble from cavitation. This chart, based on recommended practice set up by the Hydraulic Institute, gives safe limits.

Example: A pump is to operate against 105-ft total dynamic head, of which 5 ft is dynamic suction lift. What is the safe specific speed limit?

From 105 ft at bottom of chart run a vertical line to 5-ft suction-lift diagonal curve, then horizontally and find 4050 specific speed for a double-suction pump, 3200 for a single-suction unit without a shaft through the impeller eye, and 2875 for a single-suction pump with a shaft through the impeller eye.

Example: A double-suction pump good for 105-ft total dynamic head has a specific speed of 5000. What is the safe suction limit?

From 5000 specific speed for a double-suction unit run horizontally to intersect the vectical line running from 105-ft total dynamic head. These lines intersect on the +10 suction-head line. Thus, the pump must have a positive head of 10 ft on the impeller eye to operate satisfactorily.



POWER

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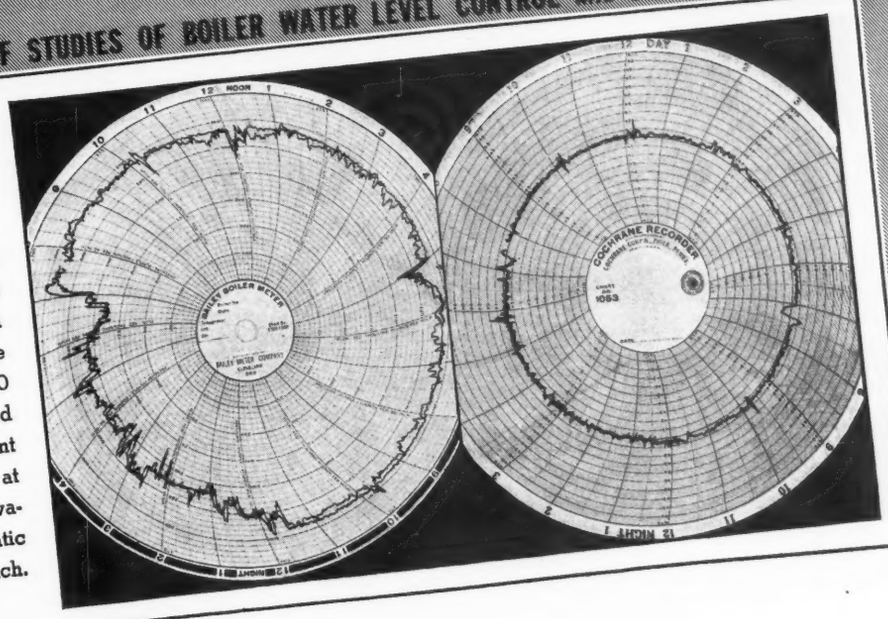
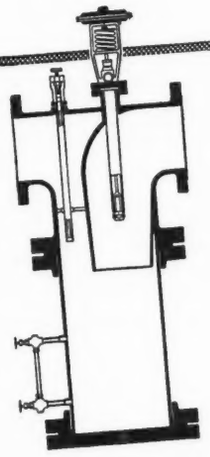
675 POUNDS W. S. P.

Fired with pulverized coal and oil, this 675-lb., 750-deg. B. & W. Integral Furnace Boiler in an Eastern utility plant (name on request) is rated at 125,000 lb. of steam per hour. Feed water averaging 25 percent make-up is fed to boiler at 372 deg. Maximum level variation with COPES Flowmatic is plus or minus one inch.



★ No need to "baby" it—gives good results right from the start



Here's a good desuperheater. The COPES is accurate for total or partial desuperheating of steam up to 1100 deg. F. Final temperature held within close limits, because cooling water is completely atomized at all flows. Water is correctly proportioned to the steam at all times because it is controlled at spray nozzle, not by a valve outside the unit. Self-contained, and easily adjusted for temperature or sensitivity. Write for Bulletin 405.

From the first day this new boiler was placed in service, the COPES Flowmatic Regulator has held boiler water level within plus or minus one inch. Through the difficult initial operating period, while instruments and other delicate controls were being adjusted, the Flowmatic fed correctly without special care or attention. And in regular service, there has been no operating or maintenance problem of any kind. That's why this utility has re-ordered COPES Flowmatic—why other modern plants are swinging to this simplified two-element steam-flow type regulator for closer feed and level control. Write for Bulletin 409-B.

NORTHERN EQUIPMENT CO., 501 GROVE DRIVE, ERIE, PA.

Feed Water Regulators, Pump Governors, Differential Valves
Liquid Level Controls, Reducing Valves and Desuperheaters

BRANCH PLANTS IN CANADA, ENGLAND, FRANCE, GERMANY AND ITALY
REPRESENTATIVES EVERYWHERE

★ GET CLOSER LEVEL CONTROL WITH THE COPES FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY FLOWMATIC ★ REGULATOR

Midwest Power Conference Records Important Advances

Engineers discuss gas turbines, gas-burning diesels, record-breaking boiler operation, power-process problems, firing with pulverized coal, oil and gas, hydro projects, power fallacies and trends, the professional status of the engineer

▶ CHICAGO, ILL., APRIL 10—In attendance, interest and quality of papers, the Midwest Power Conference, held in the Palmer House, Chicago, April 9 and 10, established a new high for this annual event. Hundreds of engineers from the midwestern states, and many from the East and South, gathered to hear and discuss papers broadly covering the power field and well balanced between utility power problems and those of the industrials.

The Conference opened with an address of welcome by City Engineer Loran D Gayton and a response by Prof Ben G Elliott (University of Wisconsin) for the cooperating institutions: Iowa State College, Michigan State College, Purdue University, State University of Iowa, University of Illinois, University of Michigan, University of Wisconsin, the Chicago sections of AIChE, AIEE, AIME, ASME, the Illinois sections of ASCE and ASHVE, the Western Society of Engineers. Mr. Gayton urged engineers to broaden their outlook and participate more actively in the affairs of the community.

Presenting the first scheduled paper, Philip W Swain, editor of POWER, reviewed some common power fallacies, stressing two that have harmfully affected public policy—the notion that water power is necessarily cheap power and the idea that the problem of supplying power to industry is purely one of supplying electricity.

Referring to the latter, he said that steam for process and heating is a more important form of industrial power than electricity if judged on the basis of total expenditures. Industry spends each year about $600,000,000 for purchased electricity and another $200,000,000 for locally generated electricity, a total of about $800,000,000. In contrast, the total cost of process and heating steam is about one billion dollars. He closed with the plea that engineers make it their business to "hew down all power fallacies and let the chips fall where they may."

The combustion gas turbine has been discussed at length in the pages of POWER, but the paper by Paul R Sidler of Brown Boveri and Co added recent information of considerable interest. At present, said Mr Sidler, a total of 12 gas-turbine driven compressor sets are in operation, all but one in the United States and in plants of Sun Oil and Socony Vacuum. Six of these sets were built by Brown Boveri and imported from Switzerland. The others were built by Allis-Chalmers under license. Several other sets for the same application (Houdry process of oil cracking) are under construction at Milwaukee and in Switzerland. All of these units develop an excess of power (over compressor requirements) for electrical generation.

Gas Turbines for Power

Speaking of combustion turbines designed exclusively for power generation, Mr Sidler discussed the efficiency gain possibly by heat recovery, and by higher gas temperature at turbine throttle. He indicated that 1200 F operation will soon be possible because machinable materials able to withstand that temperature continuously will be on the market before long. Research is also directly attacking the problem of cooling blades by air, either through hollow blades or by enveloping the blade surface in a boundary layer of cooling air.

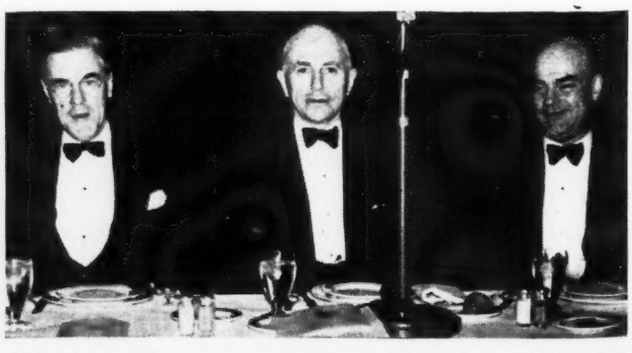
He said that a 9000-kw combustion-turbine plant (including small diesel-electric starting set and necessary switchgear) can be built into a space of 4 cu ft per kilowatt, much less than that required for a steam or diesel plant of equal output. Experiments with pulverized-fuel firing of combustion turbines are progressing favorably, he indicated.

Among recent applications Mr Sidler mentioned three for blast-furnace blowing (in Europe), also a 2200-hp gas-turbine-electric locomotive being built for the Swiss Federal Railroads. The turbo-compressor set runs at 4800 rpm and the dc generator normally at 750 rpm. Total service weight of the locomotive, including fuel oil, is 92 lb per horsepower. Efficiency is about double that of a steam locomotive and no water is required. In this country Allis-Chalmers is studying similar locomotives of larger output.

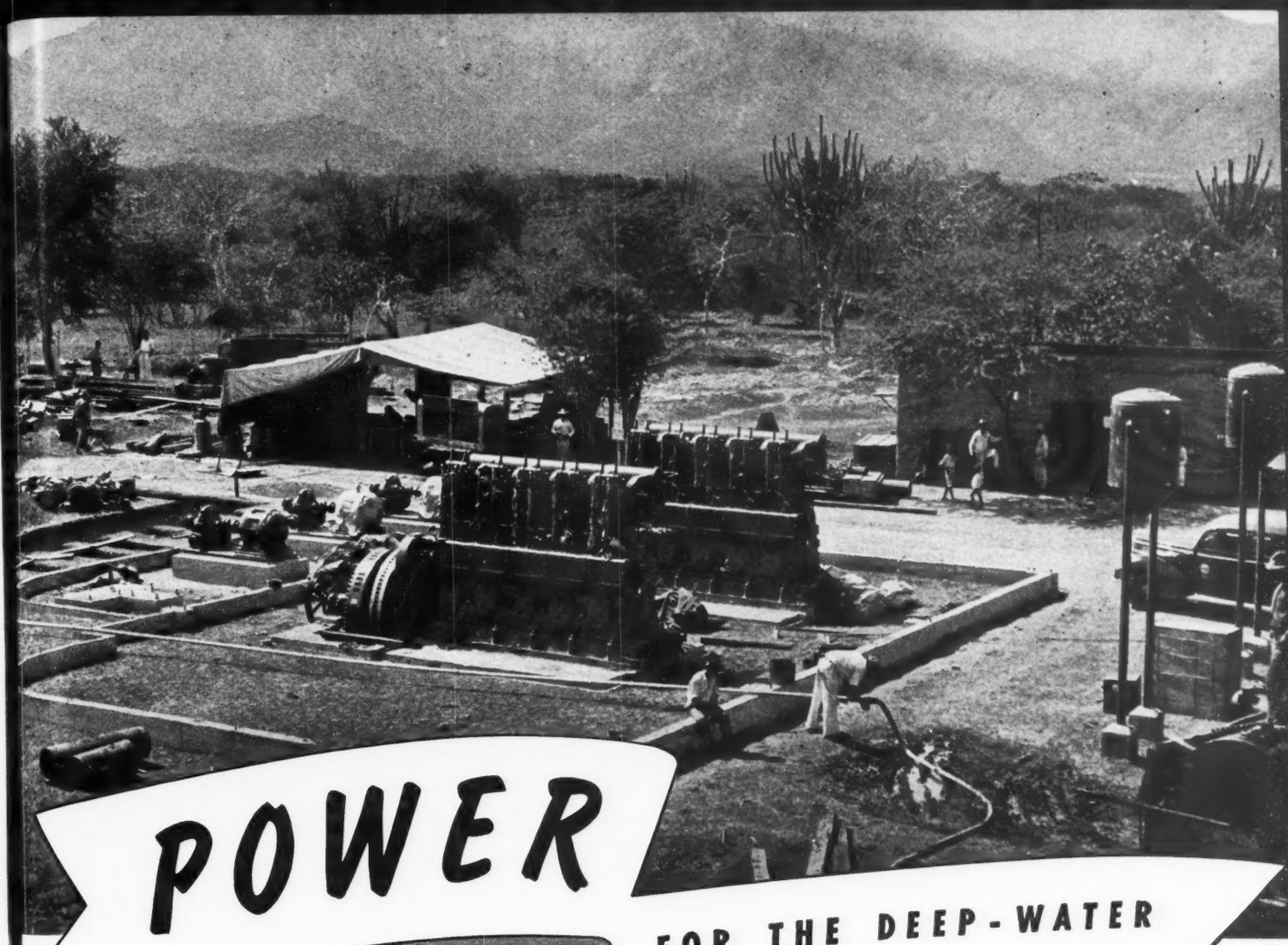
At the joint luncheon with the ASME, a paper by Dale F Reese, vice-president of (engineering) Hartford Steam Boiler & Inspection & Insurance Co, outlined the past and present accomplishments of power-equipment insurance companies in the promotion of plant safety.

Power-plant insurance differs notably from other forms, according to Mr Reese, in that it is 80% engineering and only 20% underwriting. A major company expense is the elaborate inspection program to prevent accidents. The inspectors of his own company made a total of 697,941 object inspections in 1939.

Among specific accomplishments of the



LEFT—Power process session, left to right: chairman L S Foltz, Mich. State College; Grover Keeth, Marathon Paper Mills; R L Meyer, Whiting Refinery of Standard Oil. Right—Toastmaster Alex Bailey, Commonwealth Edison (center); speakers F M Farmer, Electrical Testing Labs (left) and James W Parker, Detroit Edison, at "All Engineers" dinner



POWER

FOR THE DEEP-WATER TERMINAL at PUERTO LA CRUZ

Two 500 bhp De La Vergne Model VG diesel electric generating units furnish power for the Deep-Water loading Terminal and surrounding colony at Puerto La Cruz, Venezuela. This recently completed line of the Mene Grande Oil Company is the longest 16 inch diameter pipe line ever laid for the transportation of crude oil.

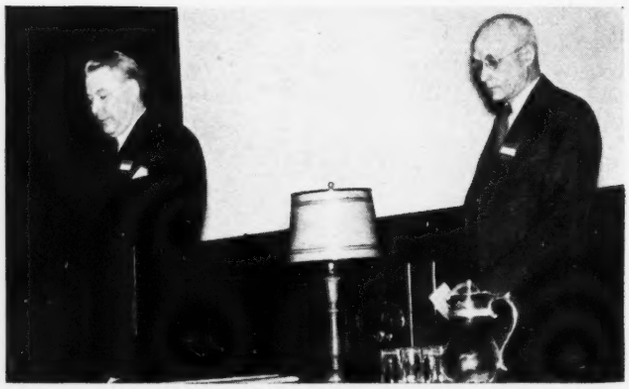
Requirements for dependability and economical operation —so obviously important in this remote region—are met by De La Vergne whose diesel installations in Venezuela and Colombia alone total more than 20,000 hp.

BLW THE BALDWIN GROUP

DE LA VERGNE ENGINE CO.

Subsidiary of THE BALDWIN LOCOMOTIVE WORKS
PHILADELPHIA

Brown Boveri's Paul Sidler (center, facing left) answers questions after his gas-turbine lecture



H W Dow tells how Nordberg diesels run on natural gas. Session chairman M P Cleghorn standing by

power-equipment insurance companies, he listed the campaign to uncover the bricked-in heads of boiler drums. Bricking promotes and conceals corrosion. One company uncovered about 10,000 buried mud-drum heads, discovered 1000 in need of early repair, and 100 in a critically dangerous condition. The paper described methods developed by the insurance companies to detect embrittlement and poor welds in boilers, and the misalignment of engine shafts.

Both of the speakers at the lively and well-attended session on small power plants were from Milwaukee: Herbert W Dow, executive sales engineer, Nordberg Mfg Co, and Parker A Moe, supt of power, Milwaukee Works, International Harvester.

Gas-Oil Diesel

Mr Dow described the dual-fuel-burning diesel engine (gas and oil), discussed its design and operation and revealed substantial progress in its application. This engine, built under the Nordberg patents, operates full diesel (compression ignition) with either natural gas or oil. It is designed particularly to utilize the low-cost natural gas available in certain regions west of the Mississippi.

In locations where the Btu cost of gas is less than that of diesel oil, the dual-fuel diesel has two advantages over an Otto-cycle gas engine: First, it operates at the much higher efficiency of the diesel cycle. Second, it meets a common situation in which contracts permit the gas company to cut off the gas on short notice (particularly in very cold weather when domestic demand rises). The engines described are designed to be shifted almost immediately from gas to oil.

The first unit, 8-cyl, 1750-hp, was installed at Lubbock, Texas, four years ago and has operated successfully from the start. In all, Nordberg has sold, during the last four years, twelve gas-oil burning diesels aggregating 24,560 hp. All have been 2-cycle units, the largest 3600 hp and the smallest 1000 hp.

On these engines, the timing of the gas delivery to the cylinder is exactly the same as that of the fuel oil. The units sold are divided about equally among municipals, public utility plants and industrials. All are west of the Mississippi at points where the price of natural gas varies between 10 and 25 cents per 1000 cu ft. The higher rates prevail in New Mexico and Arizona, but this district also pays proportionately more for diesel oil, so the gas maintains its advantage in Btu cost.

The dual-fuel-burning engine incorporates all the features of an air-injection unit. A 3-stage compressor compresses the gas to 1000-lb pressure. The positively operated needle valves that inject the fuel to each cylinder have a variable lift under direct governor control. The air-injection type of operation simplifies the conversion to oil fuel.

To change over, the compressor is purged of its gas content, and is then ready to compress air for oil injection. Separate Bosch fuel pumps on each cylinder are thrown into contact with their operating cams and meter oil quantity under governor control. The needle valves for injecting the oil operate the same as on gas.

For proper control of speed it is necessary to admit a constant amount of oil (about 5% of the full-load Btu consumption of the engine) when running on gas fuel. This acts as a kindling and stabilizing medium.

Ratings, said Mr Dow, are the same for both oil and gas. Btu consumption per kilowatt hour (based on "high heat value" of gas and pilot oil supplied) is 11,000 at full load, 10,400 at three-quarters load and 11,500 at half load.

10-Year Efficiency Record

The paper by Parker A Moe dramatically reviewed the practices and accomplishments of a plant that is nationally famous for its hair-line-precision control of the details of operation and for the astonishingly high efficiencies maintained. The present power plant of the Milwaukee works of International Harvester was erected during 1928–1929. Steam-generating equipment includes five pulverized-coal-fired steam generators, with an aggregate steam-generating capacity of 300,000 lb per hr. The plant has air-cooled furnaces, rear waterwalls, superheaters, economizers, soot blowers, fly-ash collectors and a complete set of instruments. The normal fuel is Pocahontas coal of high heat value.

An article in March, 1933, POWER reported an average over-all boiler-plant efficiency of 90.3% for three years. Mr Moe's Midwest Power Conference paper presented a record of 10 years of continuous operation at an average thermal efficieny of 89.4%, with a corresponding average stack temperature of 281 F.

During this decade the plant has operated without a single shutdown. An average of 15.3% CO_2 has been maintained with no replacements of suspended furnace arches or any furnace refractory, except a few door arches and minor repairs. No tubes have been lost on boilers, waterwalls or economizers, nor any soot blower elements. A few superheater tubes have been lost.

At the very start of operation the men were drilled in their duties, particularly in the matter of safety precautions against coal-dust explosions, proper draft regulation and maintaining desired CO_2.

The optimum of CO_2 for all ratings was determined by elaborate and lengthy tests with coals of different ash-fusion temperatures. Considering all factors, plans were laid to operate as far as possible between 125% rating and 200%, and with respective CO_2 percentages of 16.5 and 15.5.

Mr Moe posts on each fireman's instrument panel a chart showing exactly what CO_2 he should carry at each rating with the given coal. He trains his men to follow the chart closely. Each month a report shows how many fuel dollars each boiler operator has lost by drifting from the standard conditions.

All flyash and carbon accumulating in the flyash traps is automatically recirculated through the pulverizers to the furnace for reburning, so that carbon loss is practically zero.

Boilers are kept in service continuously for six months at a time to eliminate the cost of shutting down and starting up. Lists of needed repairs are accumulated, so that all can be attended to at the time of this shutdown.

Another feature of the International Harvester power plant is the elaborate system of maintenance followup. A master chart lists over 200 items to be inspected in minute detail at intervals varying from one to 26 weeks. All items for the week are dispatched to the proper men at the start of the week and checked on the chart when completed. If any jobs remain unfinished at the end of the week they are carried over to the next week—never removed from the master chart until cleared.

As a result of such foresight the plant has not had a single breakdown in

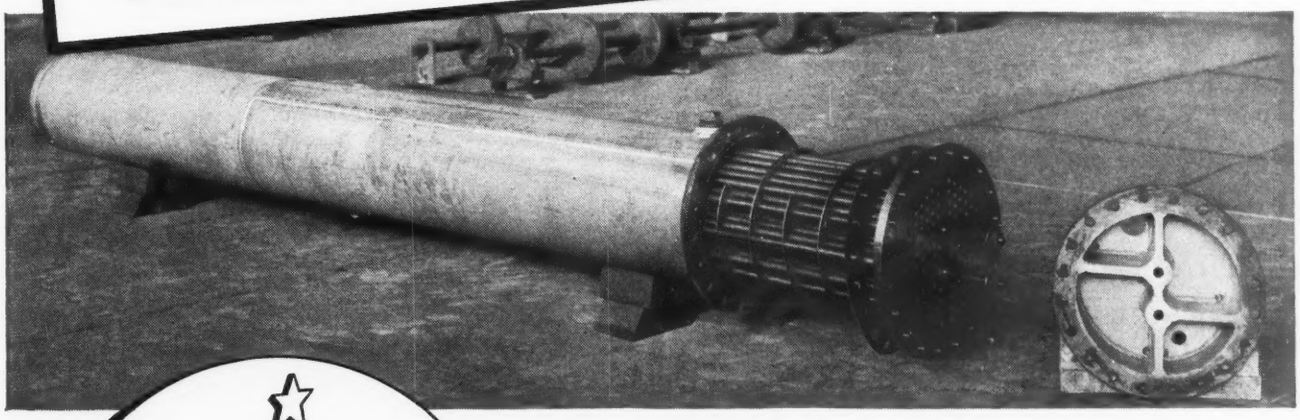
(*Continued on page 152*)

One likes it HOT

HOT WATER Storage Heaters, 10,000 gals. each, made of solid Everdur for Mary Immaculate Seminary, Northampton, Pa., by Patterson-Kelley Co., Inc., East Stroudsburg, Pa.

One likes it COLD

FREON WATER COOLER, also fabricated by Patterson-Kelley. Shell, tube sheets and baffles are of non-rust Everdur. Queens County Court House, N. Y., will use it.



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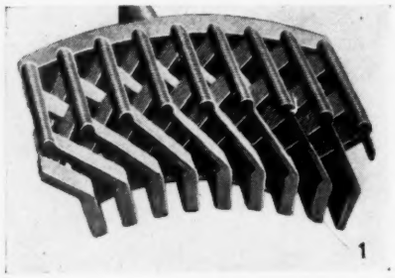
WHAT'S NEW IN PLANT EQUIPMENT

Cast-Aluminum Rotor

VALV-AMP rotor is constructed for use in larger sizes of double-squirrel-cage motors for high-starting-torque, low-starting-current service. It makes use of unique shape of rotor slot and special method of assembling rotor punchings to control flow of starting current. Result is that, without switch or other moving parts, current is



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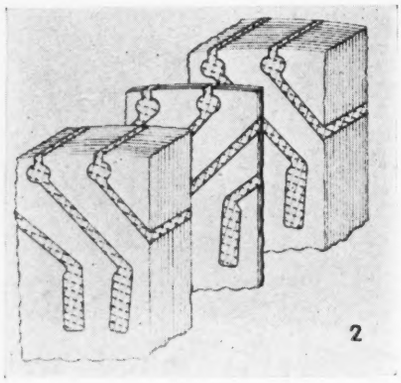
permitted to flow in the outer squirrel cage when the motor is started, producing high starting torque. Then, when motor comes up to speed, current is allowed to flow through entire rotor winding. A winding of this new construction may be of any various arrangements and is unique in that neck which connects the inner and outer cages is substantially discontinous longitudinally through the rotor. In construction shown, neck is oblique, rather than radial, as in conventional-type slot. By special arrangement of punchings during assembly, axial continuity of connecting neck is broken up, photo No. 2, which is equivalent to having a magnetic switch built into rotor itself. When rotor-current frequency is high, as at starting, this



2

switch, or valve, is closed, and no current flows through connecting neck, producing, in effect, true double squirrel cage. As motor comes up to speed and rotor-current frequency decreases, magnetic valve opens and current flows in this section.

General Electric Co, Schenectady, N. Y.

Pipe, Bolt Threader

"71 SERIES" threads pipe from $\frac{1}{8}$ to $\frac{3}{4}$ in., right or left hand, and bolts from $\frac{1}{4}$ to 1 in., right or left hand, fine or coarse thread, American or British Whitworth standard threads. Die bosses project above face of

tool body so that chips and curls free immediately. More than 100 kinds and sizes of dies available for unit, which comes in ratchet and non-ratchet models. Both models have self-centering chuck with no loose bushings.

Beaver Pipe Tools, Inc, Warren, Ohio

Bonding Process

SOFT RUBBER and Neoprene can be bonded to steel and aluminum with high adhesion strength between rubber and metal, according to manufacturer. By chemical process, composition of rubber is modified in such a way that it will attach itself integrally to metal and still retain its capacity to vulcanize itself to outer rubber layer. Dura-bond process is limited to application where temperatures will not exceed 200 F, and has adhesion strength of 500 to 700 lb psi.

Hewitt Rubber Corp, Buffalo, N. Y.

Flyash Arrestor

WHIRLEX flyash arrestor consists of a double helix in lower part of a dust chamber from 18 to 40 ft high. Device is installed in chimney above breeching level so that there is a small space between cylindrical portion and stack. Flue gases passing through the helix are given a whirling motion and flyash, thrown to outside, passes through slots in the dead space between cylinder and stack. After it reaches there it falls down by gravity through a system of collecting pipes to an ash holder.

Fly Ash Arrestor Corp, Birmingham, Ala.

Copper

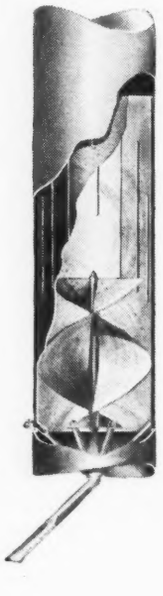
"PDCP" copper was developed for use in transformers, motors, railroads, and refrigeration. New copper is said to be free from imperfections found in ordinary copper, and is made under patented process. Manufactured without melting from electrolytic cathode copper, which is plastically converted under pressure in a reducing atmosphere at elevated temperature into smooth, dense copper bar, rod, strip, or other commercial shapes. Basically of the oxygen-free type, it is said to be the only solid copper which is not melted subsequent to the electrolytic purification process. Thus intrinsic purity of electrolytic cathode copper is retained and is greatly enhanced at high temperature of reducing gas used in the process.

Phelps Dodge Copper Products Corp, 40 Wall St, New York, N. Y.

Phosphate Comparator Set

BETZ JUNIOR set uses adaptation of colorimetric method of determining soluble phosphate. Features of set include: no strong acids to handle, test is rapid, as well as accurate, results obtained in 3-5 minutes, no boiling necessary, and no special solvent necessary to clean set after use. Set regularly furnished with two standards, 30 to 60 ppm, permitting control of phosphate within that range. Stand-

(*Continued on page* 134)



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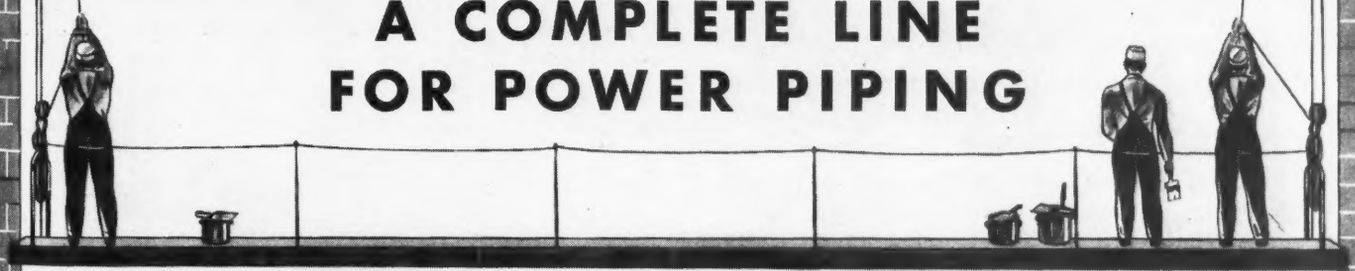

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P-5-40

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

Spring . . .

SPRING'S GOT ME, and no mistake! Every time I get set to do some high-powered thinking, I catch myself drifting off into a doze, or slipping back to idle hopes for a chance to get back home into shirt and overalls. Then I'd cut a hickory pole, and with a piece of store string, a couple of hooks and some worms I'd sure make life miserable for the sunnies down at the crick under the willow tree. Sleep and fish, fish and sleep, and no school 'til Fall. . . .

But my wife, now, she's different. Spring gets her all pepped up! Last night she collared me and made me admit that those two old hats, my shiny-seated old serge suit and my "comfortablest" brown shoes ought to go down to the Welfare. Then she added insult to injury by making me choose what ties I wanted to keep. Seems that I haven't worn a bow tie for years (on account of my double chin), and that some of the others I never wear because I can't find 'em in the bureau drawer. But she's crocheting a rug, and some of them, she insists, would make right decorative parts for it. Besides, she's housecleaning, and that's always Hell on comfort.

In fact, that's why I'm writing right now. If I go home, my pet chair will be covered by a couple of rugs and two pictures, dinner'll be in the icebox, and she might hand me a carpet beater or vacuum-cleaner handle with a meaning look. No, sir—I'm staying down here where I'm safe.

But they've got me worried here too. One of the boys just came up and said, "Chief, now that the steam load's off, why don't we go to work painting up the place, and washing them windows? Seems like we could do an extra-special job cleaning up around here and we'd all feel better!"

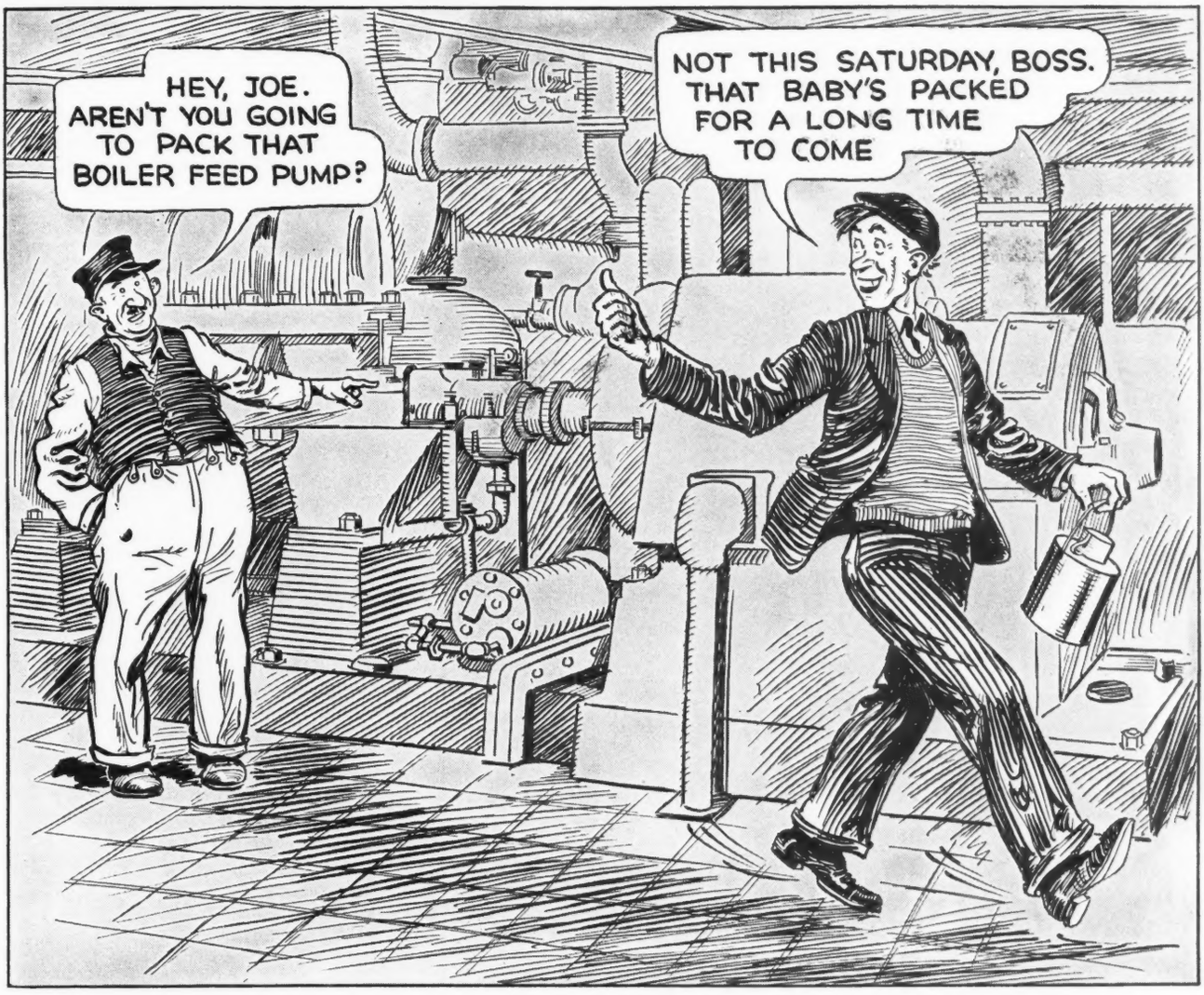
So that's what we're going to do. Clean her up, and paint her—and while we're at it fix up those "baling wire" repairs we made during the winter when everybody was too busy to do 'em right. I'm thinking about a new pump too—and maybe I can wheedle out a diesel engine for summer load—seems silly to keep steam on a boiler just to handle what little electrical load there is and provide wash-up water for the boys at quitting time.

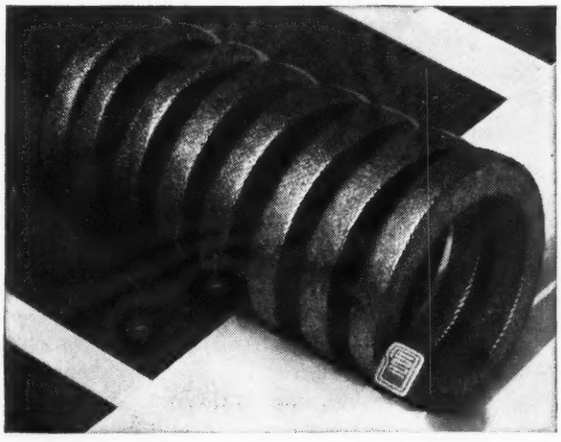
Dawgone if they haven't got me that way too! Here's trout season only a week away and I've thought up so many things to do that I can't possibly get away to throw a line in the water! I'll bet you'd be in the same fix if you started to think about it—so, if you want to go fishing, go now!

George Edwards

Engineer

KEEPING 'EM ROLLING — By WESTCOTT





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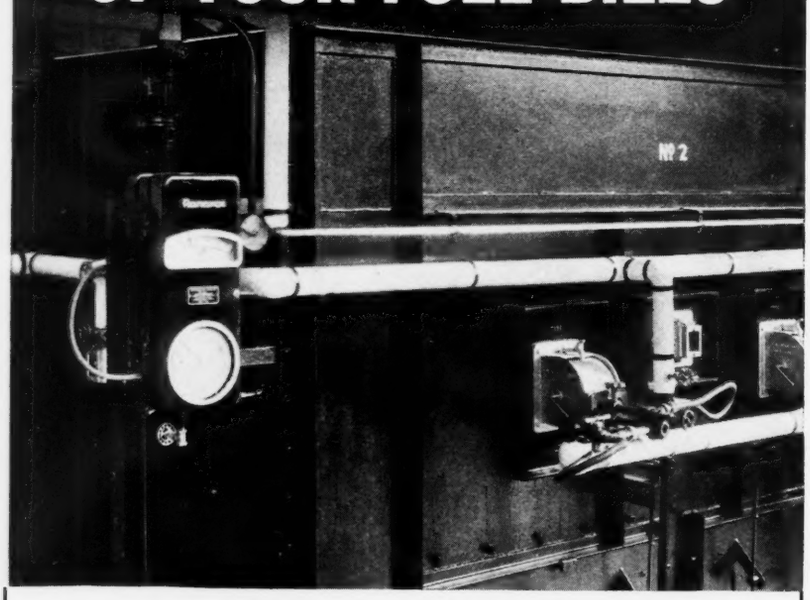

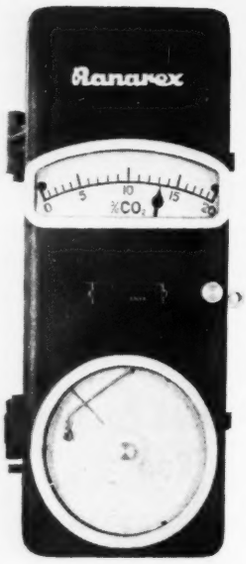

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There are no orifices, fragile parts or chemicals in the Ranarex CO_2 Indicator and Recorder. It's ruggedly built, yet so simply that a screwdriver takes it apart. It's accurate within three-tenths of one percent of CO_2—yet is unaffected by atmospheric conditions, vibrations or draft. Operates on lighting circuit. Portable models also available. Get free booklet showing how well-known firms have saved up to 10% on fuel with the Ranarex CO_2 Indicator and Recorder. Address The Permutit Company, Dept. A, 330 West 42nd St., New York.

Product of PERMUTIT

6 x 19 Wire Rope

(Continued from page 69)

layers of each strand have 9 wires. The outer wires are therefore larger than those in the other 6x19 constructions. In the 6x19 Seale rope the outer wires are actually 1.33 times the size of the outer wires in the 6x19 filler type of comparable size. Because of the larger outer wires the 6x19 Seale rope should operate over sheaves which have a diameter of not less than 30 times rope diameter.

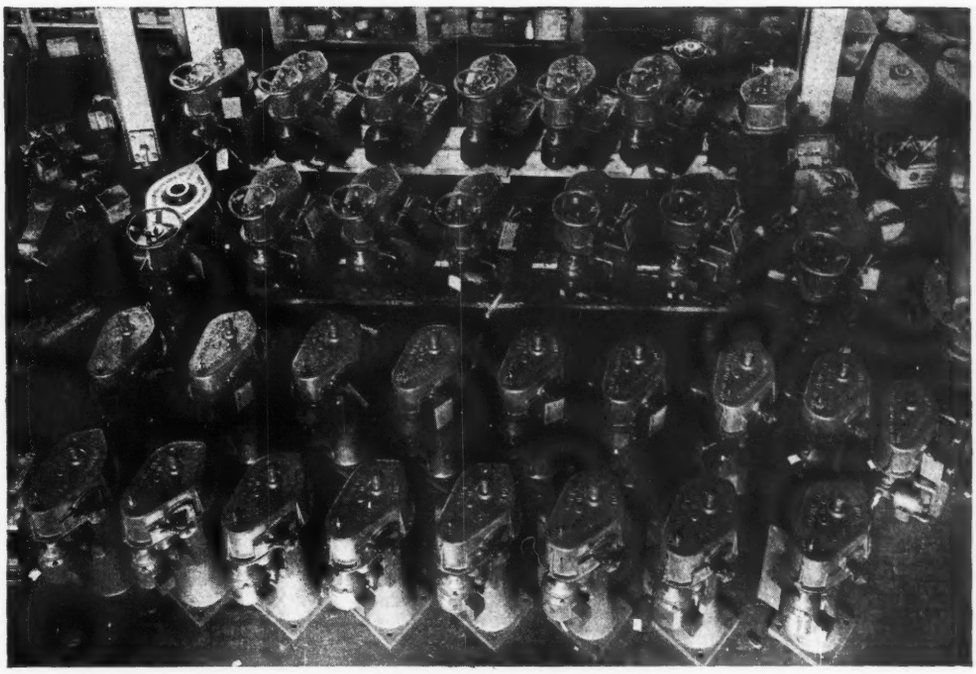
This construction has been designed primarily to withstand severe abrasion and is used principally for the horizontal movement of materials such as drag-scrapers, car-hauling systems, etc. It is also frequently used on traction passenger or freight elevators where drums are larger than 52 times rope diameter.

All these 6x19 constructions are made of standard and varying grades of iron, traction-steel, cast-steel, mild-plow-steel, extra-strong-cast-steel, plow-steel and improved plow-steel. For rated breaking strengths of these ropes the reader may consult the rope manufacturers' catalogs which quote these strengths to identical values for the lowest carbon-content iron, the least strong, to the strongest improved plow-steel.

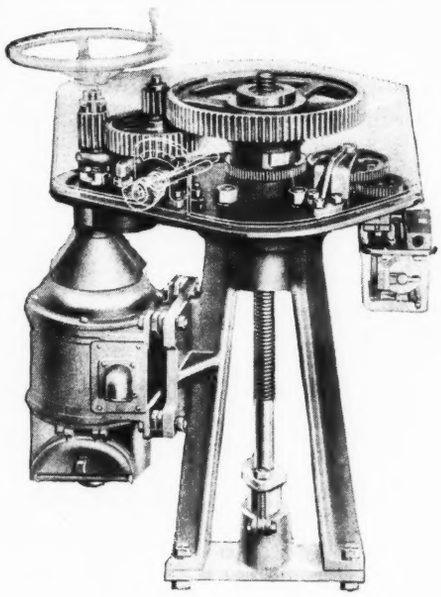
The name *grade* might imply that one rope is a better rope than another. This mistake might be made when comparing plow steel with improved-plow steel. As a matter of fact the same extreme care is used in making all grades of rope. Each grade has its specific and economical use dependent upon service conditions encountered. Many cases may be cited where a plow-steel rope would do a better job than an improved-plow-steel rope.

In rope application it is always wise to keep a minimum ratio between the rated breaking strength of the rope and the applied load equal to a value between 5 and 6. From an economical performance angle it is wise to approach this minimum value as close as possible, without going below it when selecting the grade to be used. An exception to this rule occurs when special abrasive conditions exist where it might be desirable to select a higher-carbon-content and stronger steel with greater hardness to resist abrasion. Still another exception is elevator applications where a safety factor as high as 12 may be used.

MOTORIZED VALVE CONTROL
For the Modern Power Plant



Part of a Single Order for 141 Chapman Motor Units



Chapman Motor Unit with Cover Removed Showing Simplicity and Small Number of Parts.

Chapman
Motor Units

The high pressures and temperatures of modern steam practice make motor-operated valves essential for adequate control. Chapman Motor Units are designed and built to provide positive, dependable control under the most exacting service conditions. The unit is extremely rugged and simple, with many unique features, all time-tested in actual service. One outstanding feature, especially important in the power field, is the micrometer-adjusted limit switch which controls seating to any predetermined tightness, and elimiates all possibility of *jamming*. The widespread use of Chapman Motor Units, and reorders for extensions and new plants, are good evidence of the quality of service these units are rendering in all fields of application.

Write for Bulletin describing the Chapman Motor Unit.

THE CHAPMAN VALVE
MANUFACTURING COMPANY

INDIAN ORCHARD, MASS.

DO YOU KNOW ABOUT...

- The short period of time required for the Hot Process Lime & Soda Softening for boiler feed water?
- The proper phase of a softening process in which to de-aerate . . . and how to conserve steam?
- A trouble-free Chemical Feed and proportioning equipment . . . that has no orifices . . . cannot clog . . . GUARANTEED FOR 5 YEARS?
- A PROPORTIONING Phosphate Feeder that is independent of other chemical feeders in the same system . . . no clogging nor encrustation?
- The proper filter to use in a softening process . . . and a filtering material that is resistant to the hot alkaline water?

The answer to these and other vital questions are in this new Bulletin No. 111.

The AMERICAN WATER SOFTENER CO.
WATER REFINING EQUIPMENT HEADQUARTERS
INDUSTRIAL • PROCESS • RAILROAD • MUNICIPAL • HOUSEHOLD, ETC.
322 LEHIGH AVENUE
PHILADELPHIA, PENNSYLVANIA . . .

Please send me a copy of Bulletin No. 111

Name
Address
State
City

New Plant Equipment

(Continued from page 128)

ards of 20 and 40, or any other specified ranges can be furnished. Consists of wooden cabinet, removable comparator block with 2 permanent (maximum and minimum) color standards, 2 graduated mixing-tubes with rubber stoppers, 2 graduated test tubes, one 20-cc vial and graduated pipette, 1 extra graduated pipette and nipple, one 2-in. funnel with extra-long stem, 1 box No. 5 Whatman filter paper, one 16-oz bottle Molybdate reagent, one 1-oz bottle stannous chloride (concentrated), together with instructions.

W H & L D Betz, 234 W Wyoming Ave, Philadelphia, Pa.

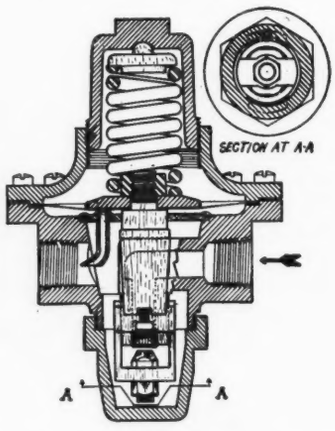
High-Pressure Plug Cock

LUBRICATED-TYPE plug cock is for test pressures up to 4000 lb. Has rated working pressure for water, oil and gas of 2000 lb. Body is forged steel and it has stainless-steel plug. Stick lubricant is inserted under lubricant screw, which can be turned down. Turning screw transmits hydraulic pressure to the seat, and in event cock becomes hard to turn, pressure exerted will loosen it.

Merco Nordstrom Valve Co, 400 Lexington Ave, Pittsburgh, Pa.

Regulating Valve

TYPE D regulating valve can be adapted for steam, cold-water, hot-water, air, various gases, oil, etc, by simply changing seat disk. Stainless-steel seat nipples are used, having various size orifices, with stainless-steel used where valves are for steam, etc, and composition for water, etc. By using restricted seat orifices of different sizes for various ranges of reduced pressure, valve is forced to open wider, there-



fore cleaning itself and reducing "wire drawing". Pressure chamber in which the diaphragm is enclosed is connected to delivery side of the valve by syphon tube. This arrangement said to prevent excessive valve-seat chatter, and also enables valve to maintain constant delivery pressure,

"Say, this new *Gilmer* GUIDE is a rich mine of helpful information!"

A PARTIAL LIST OF CONTENTS

- Comparison table of standard multiple and fractional horsepower V-Belts
- Standard Sheave specifications
- How to select drives from standard drive tables
- Revised horsepower ratings
- Standard stock drives
- Adjustable Diameter Sheaves
- Design of Special V-Belt drives
- Formulas
- Examples of calculations
- Peripheral speed chart
- Grooving dimensions of Sheaves
- WR² Flywheel effect
- V-to-flat drives
- How to figure a V-to-flat drive
- Belt selection table
- New Correction Factor Tables

96 PAGES! CONTAINS THE NEW INDUSTRY H.P. RATING TABLES

That, in effect, is what so many Engineers and Maintenance Men say when they get their copy of the new Gilmer Guide. They'd probably assumed it was "just a catalogue"—but this 96-page volume is a valuable engineering handbook. It's crammed full of information that you need constantly—charts, figures, data that'll save you hours of tedious brainwork and the risk of mistakes. It gives full engineering information and tables on both *multiple* and *fractional horsepower V-Belts*, with a complete section on *Sheaves*. Best of all, this helpful engineering handbook is *yours for the asking!*

FREE! SEND FOR YOUR COPY... NOW!

L. H. GILMER COMPANY
Tacony, Philadelphia, Pa.

Since you're offering it free with no obligation, I'd like to receive a copy of your new 96-page Gilmer Guide to Efficient Belt Practice.

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ATTENTION OF_____

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L. H. GILMER COMPANY, Tacony, Philadelphia, Pa • *"The Oldest Firm of Rubber Fabric Belt Specialists"*

What Kind of Water

The kind of *water* supplied to your boiler has a vital bearing on the kind of *service* you receive. If the water is not precisely correct, sludge, scale and corrosion combine to defeat efficiency—costing you important money over the years for extra fuel and maintenance—money, a part of which could better be spent for a SCAIFE SYSTEM installation to end these evils once and for all.

Let *The Scaife Man* give you the practical details of the benefits *you* would derive from a dependable supply of pure, Scaife-Conditioned Water, plus an analysis of your present feed-water condition—quite without obligation!

FOUNDED SCAIFE 1802

WM. B. SCAIFE & SONS CO.

General Offices, Laboratory and Works—OAKMONT, PA. (Pittsburgh District)

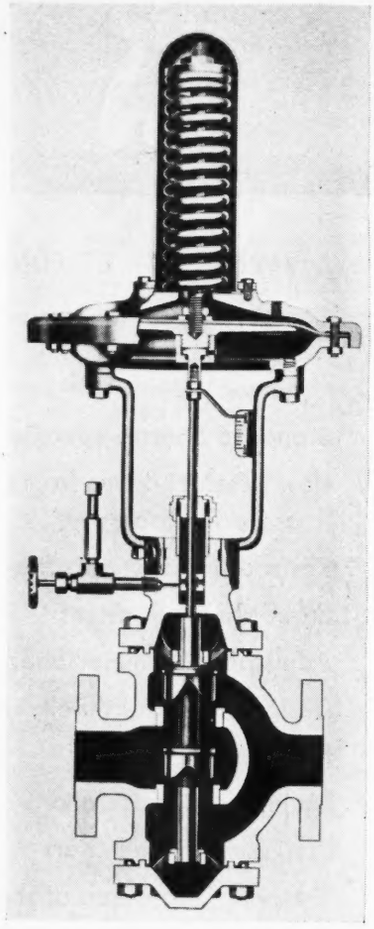
Representatives in Principal Cities

regardless of fluctuations in volume required. Springs of different sizes and strengths for the ranges of reduced pressure are interchangeable by removing spring cap.

Cash Universal Regulator Co, Marshalltown, Iowa

Valves

STABILFLO VALVES designed for accurate response to demands of control instrument. Body and plunger are made for high lift, which affords twice movement for same air pressure change as ordinary valve, according to manufacturer. Accuracy said to be provided by floating-power



motor, which is suspended, eliminating need for anti-friction bearings. Plungers are provided with top and bottom guides of stainless steel. Spider construction of guide supports prevents deposit of sediment which would interfere with valve operation.

Foxboro Co, Foxboro, Mass.

Flowmeter

LINAMETER is adapted particularly to measurement of fluids having characteristics of viscosity, corrosiveness, and solubility such as fuel oil, ammonia, hot tar, etc. Meter is of area type, with meter body installed as an integral part of pipeline, and containing a weighted disk positioned by velocity of fluid through a

New RPM DELO (DIESEL ENGINE LUBRICATING OIL) helps "CATERPILLAR" Light the World's Biggest Midway

Step right up, folks— TO ROYAL AMERICAN SHOWS!

Traveling 18,000 miles a year—entertaining 25,000,000 people in the South, Midwest and Western Canada—this big show creates all its own electric power.

Ten "Caterpillar" Diesels generate the juice for great batteries of lights—for 100,000 feet of Neon tubing—for electric motors furnishing power to the entire show.

These engines *can't* fail—and New RPM DELO sees that they *don't!* In over 4 years of operation not a single ring, piston or liner has been replaced. It has never been necessary to add oil between drains! The mechanical condition and cleanliness of all working parts are excellent. Says Royal American, "we honestly believe that much of our successful engine operation is due to New RPM DELO!"

And, the Caterpillar Tractor Co. adds to that: "*we certify that this oil is eminently satisfactory for all our Diesel engines.*" Thus another great Diesel manufacturer recommends New RPM DELO! It's the one *unequaled* oil for *your* equipment regardless of make or size. Profit by it!

New "RPM" Diesel Engine Lubricating Oil is available everywhere in the gray barrel with the blue head

Order from Your Nearest Distributor as Listed Below:

IN THE UNITED STATES

RPM DELO:
The California Company (Montana only)
Humble Oil & Refining Company
Standard Oil Company (Indiana)
Standard Oil Company (Nebraska)
Standard Oil Company of California
Standard Oil Company of Texas
Utah Oil Refining Company

Diol RPM DELO:
The Carter Oil Company, Tulsa, Oklahoma
Colonial Beacon Oil Company
Standard Oil Company of Louisiana
Standard Oil Company of New Jersey
Standard Oil Company of Pennsylvania

Kyso RPM DELO:
Standard Oil Company (Inc. in Kentucky)

Signal RPM DELO:
Signal Oil Company

Sohio RPM DELO:
The Standard Oil Company (Ohio)

IN CANADA & NEWFOUNDLAND

Imperial RPM DELO:
Imperial Oil Limited

IN BRITISH COLUMBIA & ALBERTA

RPM DELO:
Standard Oil Company of British Columbia Limited

THROUGHOUT THE WORLD

RPM DELO is available through distributors in more than 100 countries.

STANDARD OIL COMPANY OF CALIFORNIA

ADVERTISING PAGES REMOVED

Rapid Action ROTO Cleaners Save Time, Men and Money

Model 135 Air-driven Motor with self-feeding cage-type head, and air valve for one-man operation.

The new Rapid Action Roto Tube Cleaner is as superior to the old type cleaner as the modern machine gun is to the single shot rifle. With it, one man can clean more tubes by himself in an hour than a team using the old type cleaner. An air valve on the motor permits him to turn air on and off instantly, without the usual delays caused by signalling a helper.

The tremendous speed and power developed by the new design Roto motor, combined with new types of cutting heads, give you a tube cleaner which is setting new performance records in power plants everywhere. We'll be glad to prove it in your plant.

See Our Adv. in Sweet's and Write

The ROTO Company, Newark, N. J.

Other ROTO Features

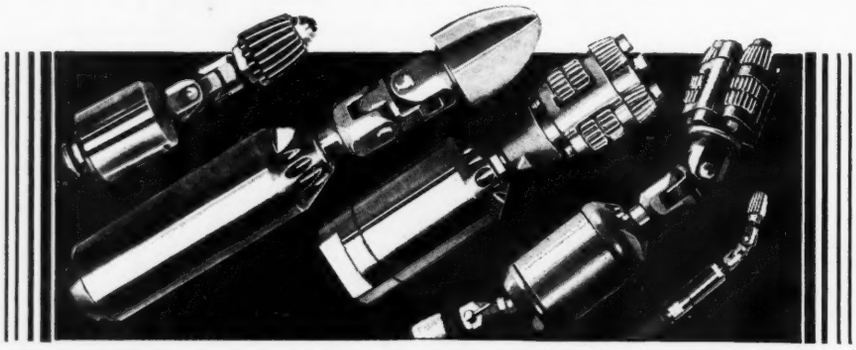
★ make better use of air consumed, without back pressure;

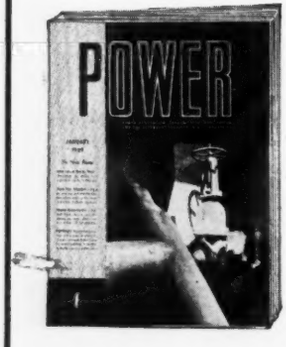
★ develop unbelievable speed and power, through new design;

★ air valve directly behind the motor permits one-man operation;

★ self-feeding cage and swing frame heads, universal joints and drills have what it takes to do a real job;

★ available for straight and curved tubes ½" to 12" I.D.





COMING — JUNE

Vital engineering data on 400 diesel and gas-engine plants installed since April 1, 1939.

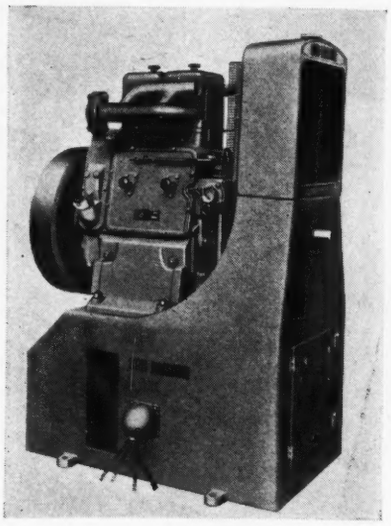
WATCH FOR IT!

tapered throat section in such a manner that disk-travel is directly proportional to flow-rate. Attached to weighted disk is rod and iron core, latter of which traverses the fields of two reactance coils surrounding pressure-tight tube of the meter body. These coils form a reactance-bridge when connected electrically to similar coils in indicating recording and integrating instrument and form means of transmitting measurement to any desired distance from meter body.

Cochrane Co, 17th St & Allegheny Ave, Philadelphia, Pa.

Diesel-Electric Set

POWR-PAK line of diesel-electric power plants consist of radiator-cooled engine, generator and control panel, assembled and ready to operate. Units range in size

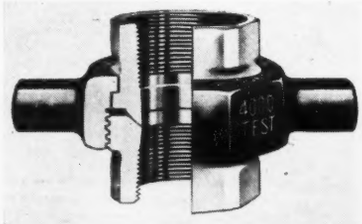


from 3.5 to 24 kw. Chief change from conventional design is placement of generator, directly beneath the engine, cutting floor space requirements. Lister 4-cycle diesel provides power for generating.

Lister-Blackstone, Inc, Milwaukee, Wis.

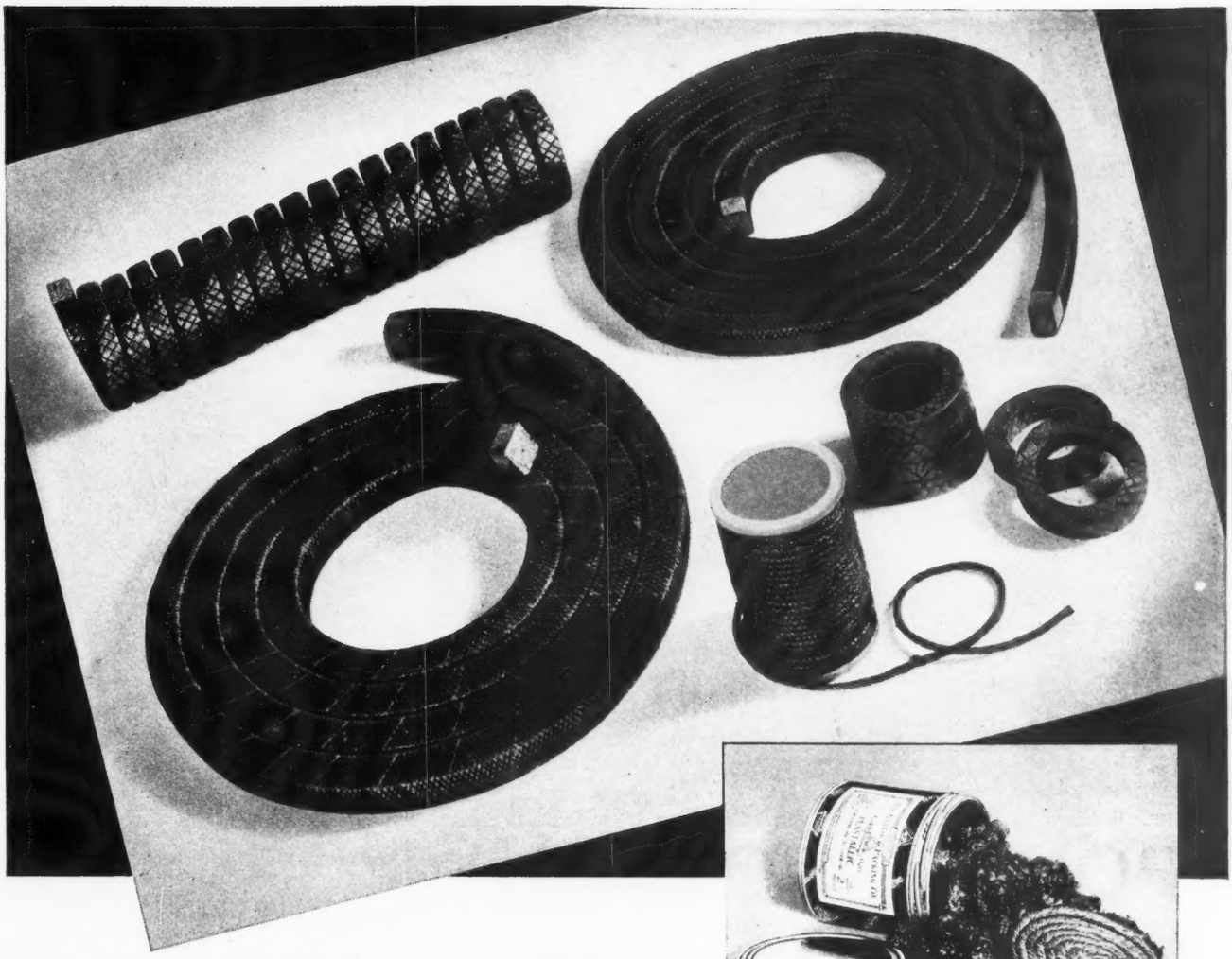
Steel Union

HI-SPEED, handle-bar forged-steel union is similar to previous models, with several improvements. New model has extra-heavy hub ends and nut; both hub ends are rust-proofed, spark-proofed and threads are permanently lubricated cadmium. Nut is rust-proofed by Parker-



izing process. Streamline seats are machined and cold-rolled and modified Acme thread has 6 pitch on 2-in. size and 5

(Continued on page 142)



You'll Like THIS Plastic Packing!

For every service where a plastic packing is desired — use GARLOCK *Plastallic*. These superior plastic packings are scientifically compounded to GARLOCK formulae. Only the purest asbestos fibre, soft metals, graphite and special lubricants enter into their construction.

GARLOCK *Plastallic* is easy to apply; in service it combines into one homogeneous mass. Our new rectangular or out-of-square coil *Plastallic* packings fit two different sized packing spaces, as they may be applied with either the long or short dimension parallel to the rod. Write for descriptive folder!

THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK

In Canada: The Garlock Packing Company of Canada Limited, Montreal, Que.

Garlock 926 Plastallic—for water, steam or air up to 550°F. Loose or bulk form, coil and ring.

Garlock 927 Plastallic—for gasoline, oils, ether, etc., up to 550°F. Loose or bulk form, coil and ring.

Garlock 928 Plastallic—for steam and hot oils over 550°F. Loose or bulk form, coil and ring.

Garlock 929 Plastallic—for water, steam and general service up to 550°F. Loose or bulk form, coil and ring.

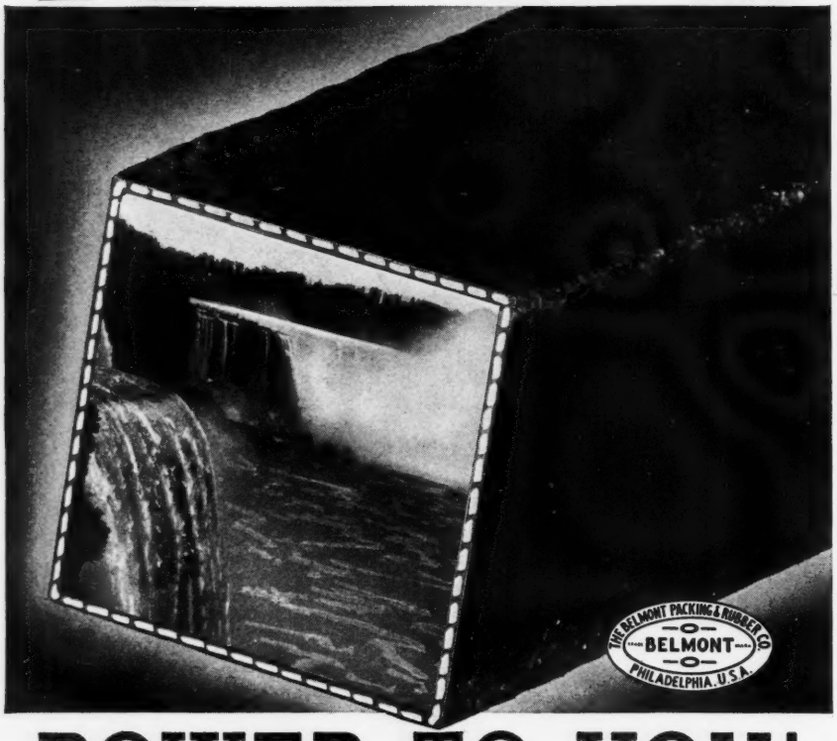
Garlock 930 Plastallic—for gasoline, oils, gases, etc., at high or low temperatures. Coil, spiral and ring form.

Garlock 931 Plastallic—for steam, water or air at high or low temperatures. Coil and ring form.

Garlock 924 Plastallic—for acids and strong chemical solutions. Loose or bulk form, coil and ring.

GARLOCK *Plastallic*

MORE



POWER TO YOU!

PACK WITH BELMONT

No matter how small—power leaks are costly. That's why Belmont takes such minute care in the construction of Belmont Hydraulic Packings.

Take Belmont 319, for example. Only the finest quality rubber friction duck is used. The hollow center, which was originated by Belmont, provides a point of least resistance for contraction and expansion. This also serves to keep friction at a minimum, since the packing tends to "breathe" towards the "hole," as varying pressures are exerted upon it in the stuffing box.

This type of construction care is not an isolated example. It's the rule for the entire Belmont Line. See for yourself. A request on your company letterhead will bring the new 1940 edition of the Belmont Catalog to you absolutely free.

SUGGESTED PACKINGS FOR WATER SERVICE

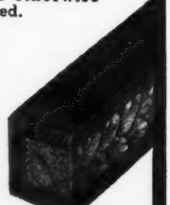
BELMONT 319

Hollow Center Packing

Made of finest quality closely woven rubber frictioned duck, wrapped on itself and moulded to size. Supplied in packing space sizes ¼" and over; lubricated and graphited unless otherwise specified.

BELMONT 9

Special Hydraulic Packing



Made of Long Line best quality Flax stitched with strong linen thread into a moulded rubber and duck channel. The double combination of casing and flax makes two packings in one against the wearing surface. Supplied lubricated and graphited unless otherwise ordered, in all packing space sizes from ¼" upward.

THERE'S A BELMONT PACKING FOR EVERY SERVICE

BELMONT

PACKINGS

THE BELMONT PACKING & RUBBER COMPANY

BUTLER AND SEPVIVA STREETS • PHILADELPHIA, PA.

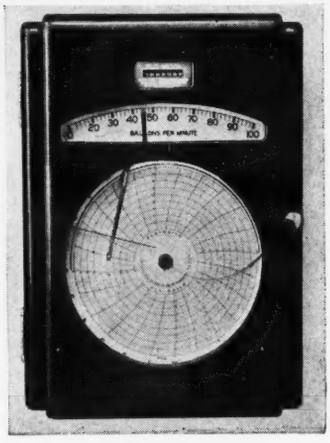
(Continued from page 138)

pitch on 2½-, 3- and 4-in. Built for steam working pressure of 700 lb at 800 F, or 3000 lb cold working.

Clayton Mark & Co, Evanston, Ill.

Flowmeter

FLO-WATCH meter for flow, level, pressure, temperature or position is precision mechanical meter designed to meet requirements for metering boiler feedwater and steam output as well as main distribution lines. While illustration shows a recording and totalizing instrument with 10-in. indicating scale above chart, unit is also furnished as recording or indicating instrument only, or as recording and totalizing instrument with or without pen pointer and segmental indicator. Temperature- and pressure-pens for registration on flow chart furnished on request. All recording instruments have evenly-graduated flow charts and all integrating instruments have positive-drive, 7-digit, straight-reading counters of cyclometer type.



Builders Iron Foundry, 7 Codding St, Providence, R. I.

Centrifugal Fan

REDUCED POWER CONSUMPTION, quieter operation and less maintenance are claimed for Silentvane Design 7. Other features are slow rotative and peripheral speeds, self-limiting horsepower characteristics with gradually increasing horsepower and volume until point of maximum

Fisher

WIZARD PILOT CONTROL

WITH THROTTLING RANGE ADJUSTMENT

1% to 75%

Top View of Integral Mounting Type 4300 Wizard Pilot — cover removed.

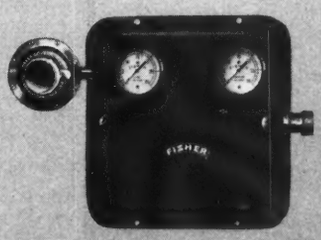
NEW · IMPROVED

★ An extremely sensitive pressure controller for accurate regulation of reduced pressures, relief pressures, pump discharge pressures and other similar services. Absolutely dependable and accurate to within 1% of the desired pressure setting. For use with Fisher Diaphragm Motor Valves which are especially designed for pilot operation. Consider these outstanding features of the new and improved Wizard Pressure Pilots:

1. New built-in throttling range provides adjustment from 1% to 75% of Bourdon tube range.
2. Vernier screw adjustment for controlled pressure setting.
3. Integral weather-proof housing for pressure gauges.
4. Larger and more sensitive Bourdon tube.
5. Gas-tight and weather-proof cases.
6. High pressure control connections and leads.
7. Easily changed from reverse to direct acting or vice versa — without changing Bourdon tube position.
8. Suitable for pressures up to 10,000 lbs.

WRITE TODAY for FREE Bulletin D1 containing complete information and latest prices.

FLUSH MOUNTING
Type 4100F Panel Mounting for remote control.



WALL MOUNTING
Type 4100S for surface or wall mounting remote control.

FISHER GOVERNOR COMPANY

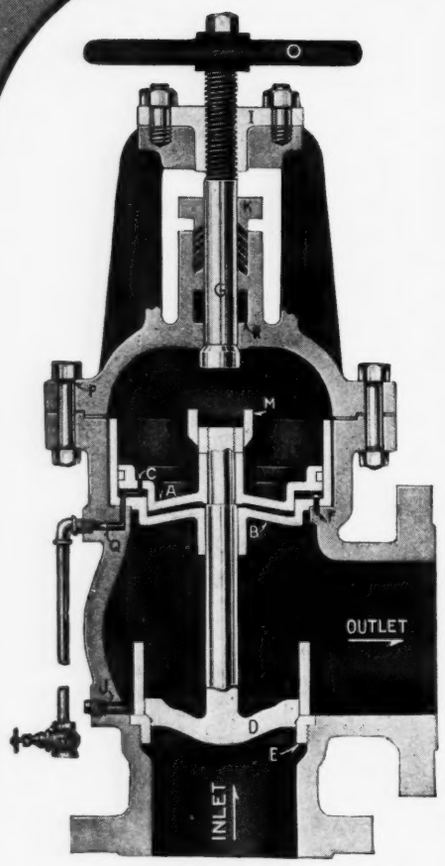
408 FISHER BLDG. MARSHALLTOWN, IOWA

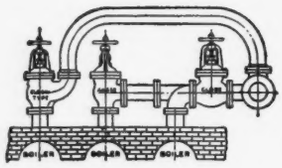
INTEGRAL MOUNTING— Type 4357T Controller with Type 4300 Wizard Pilot mounted integral with topwork of Fisher Diaphragm Motor Valve.

GOLDEN-ANDERSON

Specialty

VALVES





NON-RETURN

• A tube bursting in one boiler means that the contents of every boiler in that battery are coming through that rupture *unless* there's a good non-return valve to stop it. To guard against such destruction, install an efficient, non-return valve that *will not* and *cannot* stick—such as the G-A non-return valve shown here. As far as we know, none of the many thousands in use has ever failed.

Safeguard the most valuable thing in the world—human life—with these G-A non-return valves.

WRITE TODAY
FOR FREE CATALOG

also

Altitude Control . . .
Pressure Reducing . . .
Throttle and Emergency Stop . . . Check Valves etc.

Golden-Anderson Valve Specialty Co.

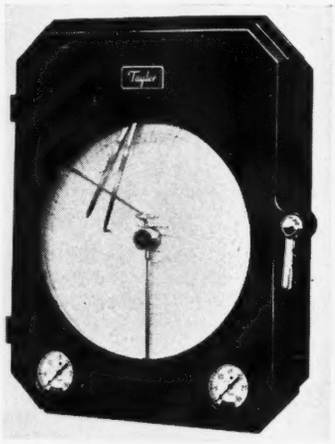
Fulton Bldg. • • • Pittsburgh, Pa.

efficiency is reached, then decreasing horsepower for larger volumes. Fan is available in all standard discharges, single and double width, single and double inlet, with wheel diameters ranging from 14⅝ in. to 87 in., static pressures to 16 in. w g.

B F Sturtevant Co, 47 Readville St, Hyde Park, Boston, Mass.

Recording Controller

FULSCOPE air-operated recording and indicating controllers combine conventional proportional response and automatic reset forms of control and introduce a third-process control effect, Pre-Act. This is a supplementary control feature which makes control-valve corrections according to control-point deviation rate. In response to sudden disturbances in the process or variations in controlling medium, over-peaking or oscillation is reduced by an immediate and relatively larger control-valve action. Automatic reset feature,



which compensates for change in load, is in the instrument case and is said to be fully adjustable over a wider range than before. Pneumatic sensitivity-reduction gives stabilized controller performance, and relation between pen-movement and output-air pressure is so linear that instrument may be used for a remote pneumatic transmitter. Simplified air system includes improved relay air valve with drilled sapphire orifice; removable 18-8 stainless-steel nozzle; built-in metal-disk auxiliary air filters to supplement large external filters; and air gages inside case. Operates on 20-lb psi air supply.

Taylor Instrument Cos, Rochester, N.Y.

Contactors

540 LINE OF HEAVY-DUTY contactors available in 100-, 150-, 300-, 600-, 1200-, and 1800-amp. sizes, and has two new features. High-efficiency arc blowout is said to quickly drive arc from contacts to large arc horns above contacts. Instantaneous rupturing of arc on arc horns, instead of contacts, lengthens contact life. Also has heavy-duty arc shields with Carbofrax inserts opposite contact tips. These lift off for inspection, but set solidly during operation. Second new feature is design and construction of electric interlock. Ver-

PIPING BY
MIDWEST

Precision Pre-Fabrication
SAVES YOU MONEY

Everybody knows that precision pays . . . that parts which fit immediately save so much money in assembly that any other kind are prohibitive in cost.

Precision in piping also pays. Piping by Midwest is pre-fabricated into a series of sub-assemblies which fit together precisely . . . which make erection a matter of relatively few field joints. Savings of time and money are obvious. In addition, the resulting piping job is superior.

Midwest Piping is pre-fabricated in modern plants, by skilled piping specialists, under controlled manufacturing conditions. Proper machinery is available to assure quality work; welders and other workmen are well trained. The work is directed by men of long experience in every type of piping.

Call on Midwest for Piping—no matter how small or how large the job.

MIDWEST PIPING & SUPPLY CO., INC.

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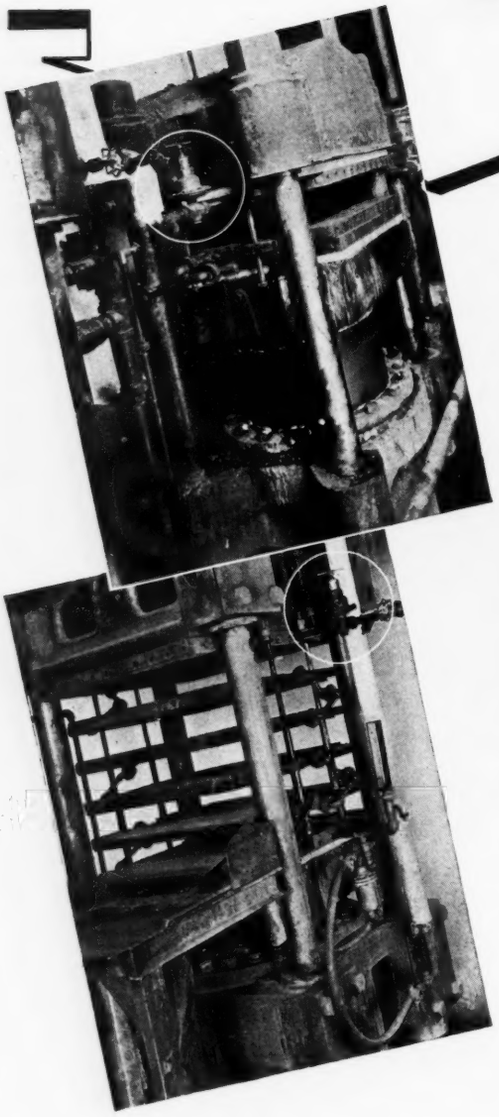
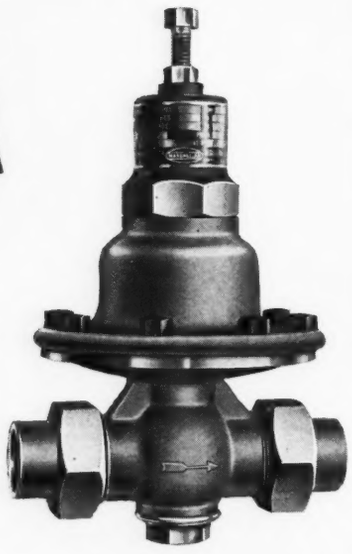
Plants: St. Louis, Passaic (N. J.) and Los Angeles • Sales Offices: Chicago—946 Marquette Bldg. • Houston—2306 Shakespeare Road • Los Angeles—520 Anderson St. • San Francisco—426 Call Bldg. • New York—(Eastern Division) 30 Church St. • Tulsa—533 Mayo Bldg.

Accurate, Reliable, Low Cost PRESSURE CONTROL



Pictured here are two of thousands of Masoneilan No. 33 Pressure Regulators now providing accurate reliable, low cost control of steam pressure on presses, vulcanizers, small stills, sterilizers and hundreds of other applications requiring small pressure regulators.

Correct design, sturdy construction, heat treated stainless steel valve and seat combine to give you sensitive control, long life and minimum maintenance costs. Though low in cost they are, like all Masoneilan products, built up to the job not down to a price.



For small steam systems specify Masoneilan No. 33. Sizes ⅛" - ¾"; ranges between 2 and 100 lbs.; working pressure up to 200 lbs. See your mill supply distributor or write for catalog.

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MASON REGULATOR CO., OF CANADA, LTD., MONTREAL, CANADA

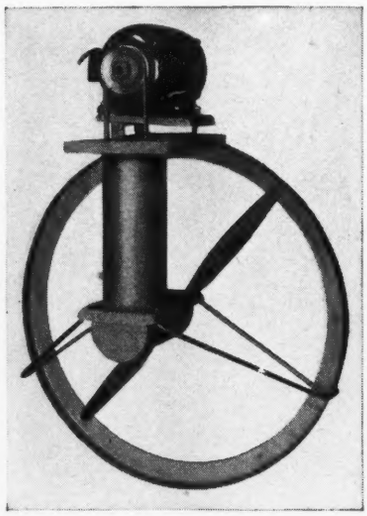
MASONEILAN

tical contact construction said to eliminate trouble in contacts.

Cutler-Hammer, Inc, 606 N 12th St, Milwaukee, Wis.

Propeller Fan

FOR USE WHERE MOTOR must be outside of airstream. Is built in sizes from 17- to 28-in. propeller diameter. Units employ Charavay overlapping ring, said to insure high efficiency by preventing back flow

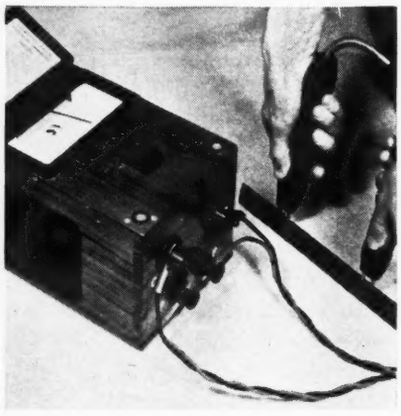


of air at propeller tips. Motor base is welded to this ring and also to a shield which encases belt. Propeller-shaft bearings are completely enclosed.

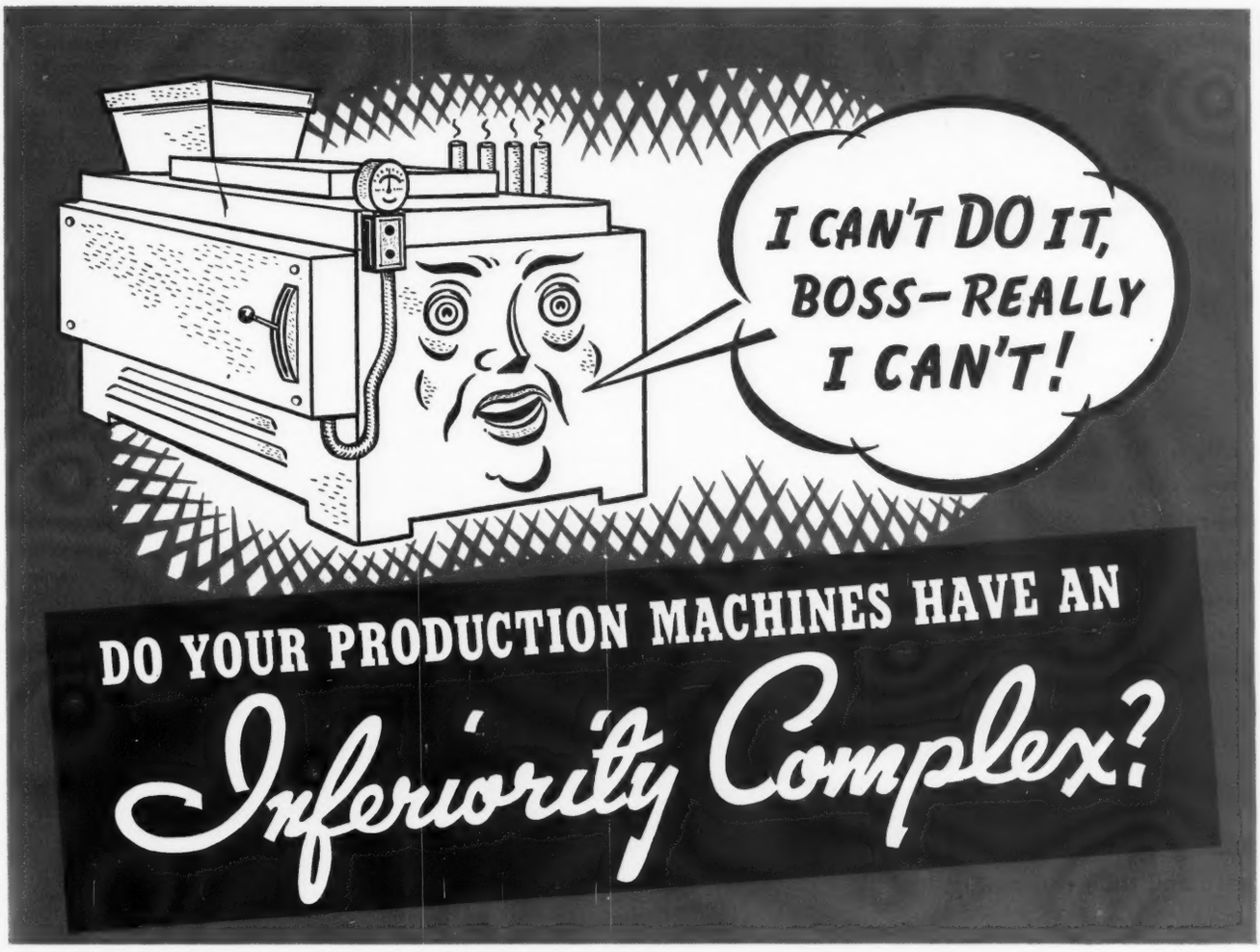
Hartzell Propeller Fan Co, Piqua, Ohio

Ohmmeter

"DUCTER" low-resistance ohmmeter is direct-reading, cross-coil, true ohmmeter for measuring low resistances. Operates on dc fall-off potential method, but instead of



using separate current and voltage measuring instruments, result is indicated directly. Moving system consists of two coils mounted rigidly together on a common axis in field of a permanent magnet. Current in current coil is proportional to that through resistance under test. This tends to move the pointer toward zero on the scale. Current in potential coil is proportional to drop between potential contact points across resistance under test,



DO YOUR PRODUCTION MACHINES HAVE AN *Inferiority Complex?*

When machines are handicapped by inflexible, unvariable speeds they can do only so much and no more. They fail to keep up with production demands, get "out of step" with other machines, spoil materials by operating too fast or too slow, and hold back quality by inability to match speed with skill of operators.

But equip these same machines with REEVES Variable Speed Control and watch them perform! Operating at the *exact* speeds necessary for best results, under every condition, they turn out more work, better work and work at lower cost.

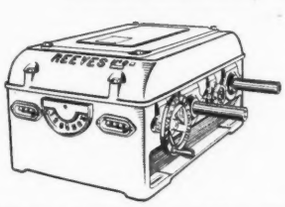
Let our trained engineers search out the fixed-speed machines in your plant to determine if they are the "bottle-necks" that are jamming your delivery schedules. Find out how inexpensively REEVES Speed Control units can be installed on these machines, to speed up your output.

Only REEVES offers a complete line of speed control units from which to choose the proper type, size, and speed ratio, to meet your needs correctly. Nation-wide staff of seasoned, factory-trained speed control engineers. Send for Catalog M-397.

REEVES PULLEY COMPANY • DEPT. F • COLUMBUS, INDIANA

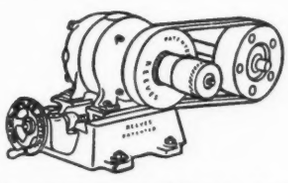
REEVES SPEED CONTROL

These Modern, Compact Units Take the "Can'ts" Out of Production Processes



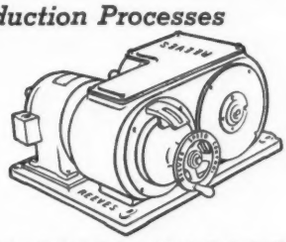
VARIABLE SPEED TRANSMISSION

Basic REEVES principle of variable pitch V-belt driving between two pairs adjustable discs. Fifteen sizes, fractional to 78 h.p.; speed ratios 2:1—16:1. Open and enclosed, horizontal and vertical designs, remote and automatic control.



VARI-SPEED MOTOR PULLEY

Forms direct drive from any constant speed motor to driven machine. Built in ten sizes, fractional to 15 h.p.; speed variation over 3:1 range. Available with countershaft, gear reducer mounting and remote control.



VARI-SPEED MOTODRIVE

Combining constant speed driving motor, variable speed mechanism and (where required) gear reducer. Uses any make standard NEMA ball bearing motor. Five sizes, fractional to 10 h.p.; speed ratios from 2:1 through 6:1.

Look What You Save

1. Remove Bonnet.
2. Unlock Seat Rings.
3. Lift out Seat Rings.
4. Insert new rings. Tapered lugs on rings fit into corresponding machined slots in valve body.

Fig. 0304

You know that welding balls, pipe chips, dirt or sediment may cut and ruin valve seats the first time a valve is opened.

Renewal of the *screwed-in* type of seat is difficult and expensive under favorable conditions, and almost impossible without removing the valve from the line. Care must be taken not to strip the threads in the valve body or the valve must be scrapped. And after seats have been removed, facing and fitting new rings to a tight seat is expensive and time consuming.

New rings can be inserted in a Fairbanks *Renewable* Iron Body Gate Valve by one man in from 10 to 30 minutes—depending on the location and size of valve—without removing it from the line. Therefore it saves enough time and money in one or two renewals to pay for itself.

You can get Fairbanks Valves from distributors in any large city.

Write for Catalog No. 21

THE FAIRBANKS COMPANY
Valves, Dart Unions, Hand Trucks and Wheelbarrows

Executive Office:
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Boston, Pittsburgh—Distributors in Principal Cities.

Factories: Binghamton, N. Y. Rome, Ga.

Valve illustrated is Fig. 0304

Fairbanks Renewable Valves

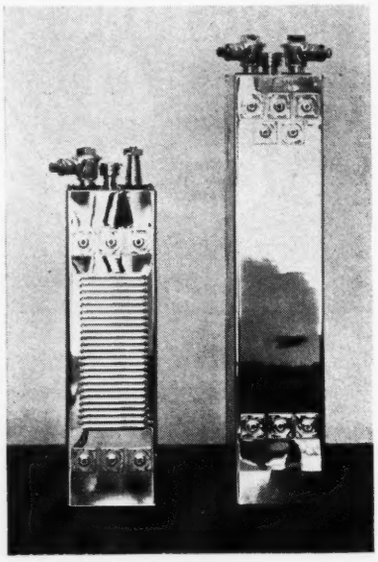
and tends to move pointer to top of scale. As moving system is not controlled by any other force, its final position is dependent only on equalization of these two opposing forces. It therefore indicates resistance in ohms and fractions of an ohm.

James G Biddle Co, 1211 Arch St, Philadelphia, Pa.

Storage Battery

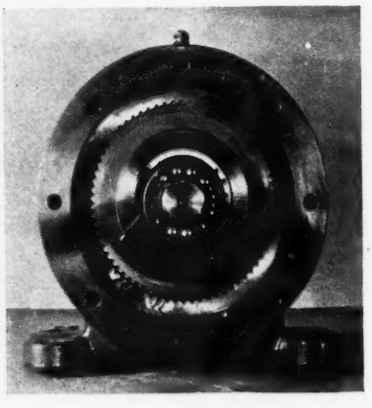
D-TYPE cell has been developed for use wherever increased power and capacity are required and especially where floor space is limited for battery compartment. New type cell, right in illustration, has about one-third more capacity, is about ⅓ higher than C-Type and has about same horizontal dimensions as smaller unit. Other features claimed include rapid heat dissipation, no electrolyte stratification, rapid charging, freedom from discharge limits and mechanical durability.

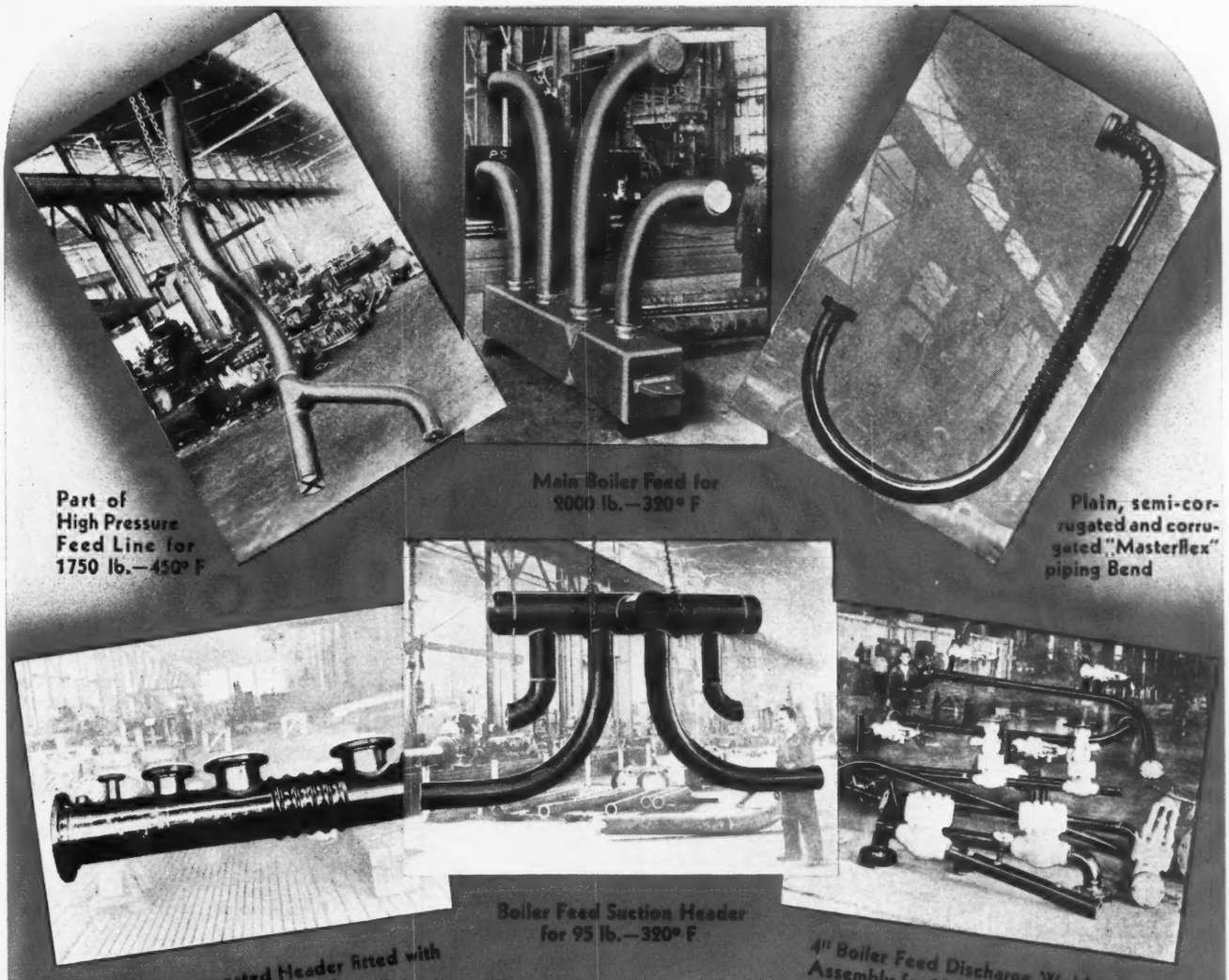
Edison Storage Battery Div, Thomas A Edison, Inc, West Orange, N.J.



Speed Reducer

DOUBLE-SPUR or combination spur and internal gear, ball-bearing mounted on drive shaft eccentric, meshes with stationary internal gear, and provides high ratio speed reductions without large gears or drives. In mesh with the secondary gear is either a spur or internal gear





Part of High Pressure Feed Line for 1750 lb.—450° F

Main Boiler Feed for 2000 lb.—320° F

Plain, semi-corrugated and corrugated "Masterflex" piping Bend

Partially corrugated Header fitted with outlets and nozzles

Boiler Feed Suction Header for 95 lb.—320° F

4" Boiler Feed Discharge Welded Pipe Assembly for 1000 lb.—250° F—Pipe of Carbon Steel—Valves of Carbon Moly

THESE KELLOGG PREFABRICATED HEADERS ETC. OVERCAME MANY PIPING DIFFICULTIES....

Kellogg prefabricated piping assemblies, headers, bends, tangents, etc. provide the most satisfactory answer to many piping problems.

Consulting engineers, operators of central stations, industrial and marine power plants have found that a satisfactory method of solving their difficult piping problems is to turn the entire responsibility over to the M. W. Kellogg Company.

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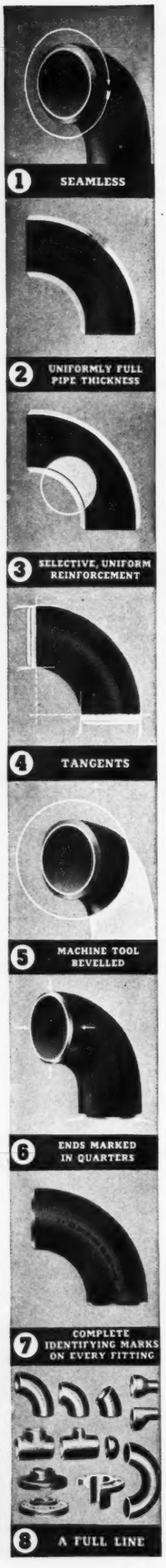
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Of course

—the fittings with the MOST advantages are the fittings that can be used to BEST advantage.

WeldELLS have these eight features that are combined in no other fittings.

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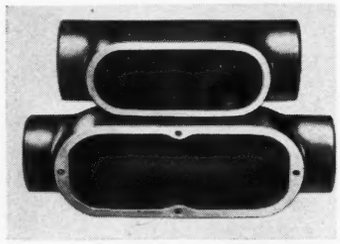
TAYLOR FORGE
WeldELLS
Seamless Pipe Fittings for Welding

which is solid and concentric with output shaft. Eccentric drives initial spur around pitch line of stationary internal gear, and, since initial spur and secondary gear are solid, speed of latter is controlled by ratio between initial spur and stationary gear.

Brad Foote Gear Works, 1301 S Cicero Ave, Chicago, Ill.

Condulets

FORM 8 SERIES CONDULETS have wiring chamber wider and longer than other condulets of comparable size, and have



extra wide surface for gasket between condulet and cover. Blank sheet-steel and cast-alloy covers are made for all sizes, and blank Bakelite covers may be drilled, where more than five wire holes are required.

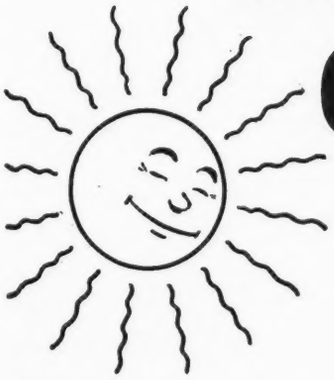
Crouse-Hinds Co, Syracuse, N. Y.

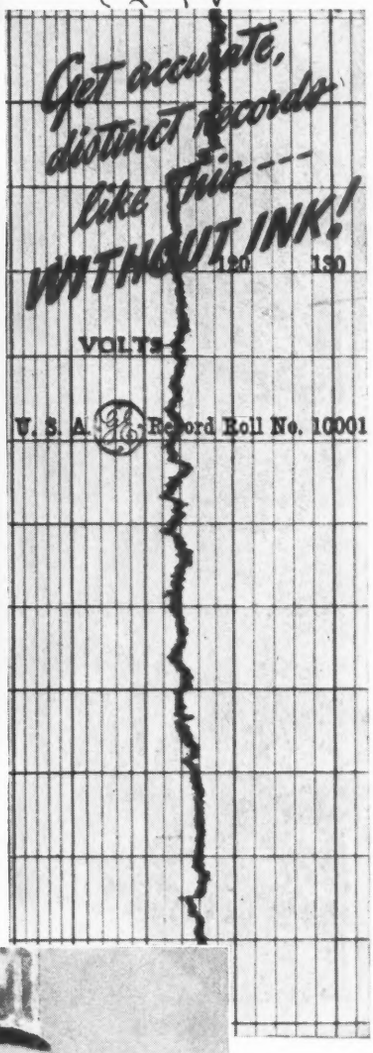
Air-Gas Radiotrol

AIR-GAS units produce mixture of constant proportion, making both fluids interdependent while passing through an aspirator and an atmospheric regulator respectively. Control valve has an adjustable port that can be set to insure effective control of air over the whole motor operating range. Also has external bypass to furnish air at blower pressure to auxiliary diaphragm on atmospheric regulator when control motor goes to shut-off position. Force from this diaphragm actually closes off all gas flow from burners at this point, which is said to eliminate over-riding of temperatures at low temperature setting.

North American Mfg Co, 2910 East 75th St, Cleveland, Ohio

Voltage surveys made easier with this NEW G-E RECORDER





At Temperatures from —10 F to 120 F

The Type CF-1 is an easy-to-use, inkless recorder specially designed for voltage surveys, but easily adaptable for other voltage-recording jobs. Here are a few of its important features.

No Ink Is Used

There's no ink to spill, blur, freeze, or evaporate. This makes it possible to obtain accurate records in extremes of temperature—from —10 F to 120 F. On rapidly fluctuating loads, a record of the important "highs" and "lows" is made on the chart, rather than the painted blur obtained with ink recorders under these conditions.

It's Lightweight

The G-E Type CF-1 recorder weighs only 12 pounds—is easy to carry and easy to mount on walls or poles.

For Indoor or Outdoor Use

A sturdy, attractive, aluminum-alloy case protects the instrument from weather and hard use. It will operate satisfactorily under all conditions for as long as thirty days without attention.

Low-priced

The price of this newest addition to the complete line of G-E instruments is unusually low, but accuracy, reliability, and quality are high.

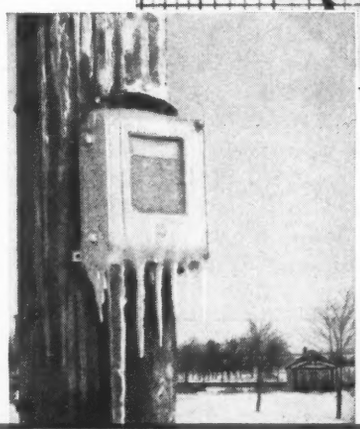
For further information about this new portable, inkless recording instrument, call your nearest G-E office or write for Bulletin GEA-3187, General Electric, Schenectady, N. Y.

Type CF-1 inkless recording voltmeter. (Also available as ammeters)

TEMPERATURE-COMPENSATED VOLTMETERS

To obtain still higher accuracy over a wide temperature range, Type CF-1 voltmeters (rated 0–140 and 0–140/0–280 volts) are available with temperature compensation for the 0–140 range. Temperature-compensated voltmeters give you:

1. Greater precision in recording limits of voltage variations.
2. Dependable data for making profitable system changes.
3. Revenue protection. No chance for ill-advised lowering of regulator settings.

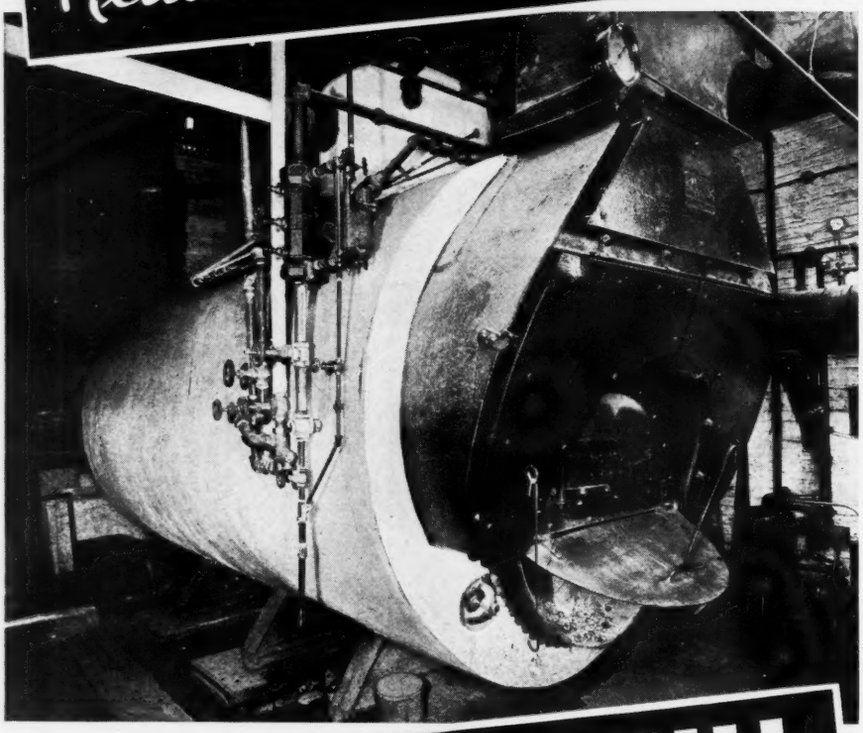


HEADQUARTERS FOR ELECTRICAL MEASUREMENT

GENERAL ELECTRIC

602-3

Heat Losses Through Shell Reduced to Minimum



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Heat Insulation Products

In order to hold radiation loss to a minimum and maintain comfortable furnace room temperature, B-H *high temperature and moisture resistant* Black Rockwool 2" Blankets finished with ½" coat of B-H No. 1 Insulating Cement were used to insulate this 125 H.P. Scotch Marine Boiler. Steam pressure is maintained at 125 lbs. resulting in 350° F. within the shell.

More and more power plants in all branches of industry are looking to B-H insulations to provide increased operating efficiencies, the reduction of heat losses and outstanding durability of the insulation itself.

Send for Catalog

for complete data on entire line showing applications, insulating efficiencies, heat loss charts, etc. of

B-H Rockwool Blanket
B-H No. 1 Insulating Cement
B-H No. 100 Pipe Covering
B-H Insulating Block
B-H Weatherseal

and other B-H insulating materials efficient up to 2000° F.

BALDWIN-HILL CO.
575 Klagg Ave. Trenton, N. J.

BALDWIN-HILL B-H INSULATIONS

Midwest Power

(Continued from page 126)

10 years or lost a single major bearing in either engine or boiler room.

Speakers at the power-process session were Grover Keeth, Chief Engineer, Marathon Paper Mills Co, Rothschild, Wis., who spoke on paper-mill power, and R L Meyer, Supt of Utilities, Whiting Refinery, Standard Oil Co.

Mr. Keeth said that 300 lb is the minimum paper-mill boiler pressure if 125-lb pressure steam for the digesters is to be bled from the turbine. Mr Meyer stressed the complexity of the power-steam load relationship in oil refineries and its variation from one season to another and from one plant to another. The hourly variations, on the other hand, are very small.

The shift in 30 years from straight separation of petroleum fractions by distillation to wide use of cracking brought the need for much higher still pressures. Today these run from 1200 lb to as high as 4500 lb vapor pressure.

Over the years the demand for process steam has decreased and the electrical load increased making it necessary to use far higher steam pressures to generate the electrical load as a byproduct. The minimum steam economic pressure today is about 400 lb.

Varying conditions lead some refineries to buy all power, others to make all and still others to operate cooperatively with a high-pressure utility plant built alongside (as by the Pacific Gas and Electric Co.)

About 400 engineers filled the assembly room for the session devoted to the fuel problems of power plants. Speakers were Martin Frisch, chief engineer, Boiler and Pulverizer Division, Foster Wheeler Corp, and H A Kleinman, engineer, Peoples Gas Co, Moline, Ill.

Mr Frisch outlined the design essentials for steam generators burning pulverized midwestern coals. These coals have the following characteristics: (1) low ash-

Parker Moe (facing camera) superintendent of power, Milwaukee works of International Harvester, relaxes after reporting 10-years of boiler operation at an over-all efficiency of 89.4%

SEE all around THE PROBLEM

the big thing in Condenser Tubes is the name Revere

BY PRESCRIPTION

℞ Choice of eleven different alloy compositions to meet your special operating conditions.

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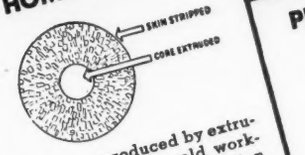

Tubes are produced by extrusion followed by cold working. The extrusion operation provides clean, dense, sound metal free from defects and impurities.

PRECISION PROVED

Rigid inspection at every step of production maintains Revere condenser tubes in conformity with rigid mechanical, metallurgical and chemical specifications.

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Six Revere mills and coast to coast sales offices give you rapid, personalized service.

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ENTRANCE *Means* EXIT!

"The Entirely Different Boiler and Engine Treatment"

Entrance of Sand-Banum into your boilers and engines means exit of scale and corrosion!

This pure colloidal concentrate comes in 16-ounce cans — ready to use. Ounces do a better and safer job than hundreds of pounds of ordinary boiler chemicals. Regardless of the operating conditions or the nature of the water used Sand-Banum increases power plant efficiency. And it is so simple to use—each can protects a 250 Hp. boiler for a month. Costly and time-consuming water analyses are no longer necessary when Sand-Banum is on the job.

Do as hundreds of others have done. *Try it in your own equipment* for 30, 60 or 90 days. Then if you are not entirely satisfied with results—YOU PAY US NOTHING!

Send for FREE copy of BOILER SAFETY RULES: 42 rules that will prevent accidents, suitable for hanging in boiler room will be sent you without obligation. Write us today—

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Instruments for Measuring Speed

Centrifugal, Chronometric and Vibrating-Reed Types

Write for descriptive Bulletin 1575-W

Jagabi Type A Universal Hand Tachometer

A precision instrument for measuring speeds up to 40,000 r.p.m.

JAMES G. BIDDLE CO.

1211-13 ARCH STREET *Electrical and Scientific Instruments* PHILADELPHIA, PA.

softening and fusing temperatures, (2) small coking tendency, (3) generally high total moisture content, (4) low to moderate grindability.

Most midwestern coals, said Mr Frisch, are easy to burn in pulverized form, but are likely to give trouble from slagging. To control slag he recommended long flame path, short-flame burners, finely ground coal, large furnace and the maximum amount of radiant-heat-absorbing surface.

Slag control, he pointed out, becomes more difficult with increasing size and capacity of units. Furnace volume should increase faster than capacity to balance the decreasing ratio of furnace wall to cubical content. Beyond a certain size it may be necessary to subdivide the furnace by radiant-heat-absorbing partition walls.

An earlier paper of the Conference presented the dual-fuel diesel as an economical and convenient method of power generation where natural gas is a cheaper fuel than oil, but may be shut off on short notice. In many regions the same applies to gas for steam generation in that it is the cheapest fuel, but the operator may be compelled to shift quickly to coal or oil when the gas lines are heavily loaded.

Mr Kleinman discussed this problem of intermittent boiler firing where one fuel is gas purchased on an "interruptable" basis. He listed the following firing combinations as available for such service: gas and oil burners, gas burners and stokers, gas and pulverized coal burners.

The paper confined itself to a gas-pulverized-coal combination arranged for changeover without interrupting steam service. His analysis showed a reduction in air volume and fan power when burning gas. Gas produces more moisture and gives a higher dew point in economizer and air heater.

Where 15% CO_2 is correct for coal, 10.8% would be about right for gas. Where the two fuels are burned simultaneously, the CO_2 must be adjusted according to the proportions of gas and air.

In the session devoted to hydro power, papers were presented by George P Steinmetz, chief engineer, Wisconsin Public Service Commission, L F Harza, Harza Engineering Co and James S Bowman of the TVA.

Mr. Steinmetz discussed small and medium sized hydro plants with particular reference to those of Wisconsin. His state contains 179 utility and industrial hydro plants totaling 553,000 hp.

Mr Harza outlined the plans and present status of the Santee-Cooper Navigation and Power Project in South Carolina. Mr Bowman discussed the hydrological factors affecting the design of dams.

The well-attended informal "All Engineers" dinner on the evening of April 9 gave an opportunity for addresses less concerned with technical details and more with the status and opportunities of the engineer as a professional man. Toastmaster was Alex Bailey, chief operating engineer of Commonwealth Edison.

The speakers were F Malcom Farmer, president of the AIEE and chief engineer of the Electrical Testing Laboratories of New York and James W Parker, ASME vice-president and chief engineer of Detroit Edison.

CONTROL of TEMPERATURES in Power Piping Fabrication
CONTROL OF TEMPERATURES IN BENDING FURNACE.
X-RAY INSPECTION OF WELDS.
HYDROSTATIC TEST.
INSPECTION FOR GRAIN SIZE.
MAINTENANCE OF HEAT DURING WELDING.
CONTROL OF ANNEALING TEMPERATURES.
STRESS RELIEVING AFTER WELDING.

FROM beginning to end, a Blaw-Knox Power Piping job never leaves the plants of the Company. All of the facilities and equipment for the fabrication and control of High Pressure-High Temperature Piping are included within the Blaw-Knox organization. Plants, special machinery, laboratories and highly skilled personnel enable every procedure necessary for the best of piping fabrication to be carried on without the necessity for subletting portions of the contract to secure the use of outside facilities.

A NEW BOOK

Soon ready for publication FLEXANAL CHARTS by E. A. Wert and S. Smith, sponsored by Power Piping Division of Blaw-Knox Co.

It is now possible for engineers using this book to figure stresses in high pressure-high temperature piping systems by means of graphs and highly simplified formulae. This book is priced at $3.00 but will be sent gratis to engineers who ask for it on their business letterheads.

BLAW-KNOX COMPANY
POWER PIPING DIVISION

1525 PENNSYLVANIA AVENUE, PITTSBURGH, PA.

IN THE CONSTANT WAR ON FRICTION

On every front where men fight friction, Dixon's Ticonderoga Flake Lubricating Graphite has earned unmatched honors. In the face of intense pressures, extreme heat and cold, in floods of solvents, this famous graphite stays on the job and does its work. As a severe-service lubricant in powder form, as a co-lubricant with grease or oils, as a coating for gaskets and packing, there never has been a substitute through all the years of engineering progress. The square red can is known, respected and used throughout the world. Practically all industrial distributors carry it.

GRAPHITE EXCELLENCE SINCE 1827

OTHER DISTINGUISHED DIXON PRODUCTS

TWO POPULAR GRADES

Particle Size No. 1	Particle Size No. 2
Large, unctuous flakes.	Finely subdivided powdered flakes.

For descriptive literature, write Dept. C-94

JOSEPH DIXON CRUCIBLE CO.
JERSEY CITY, NEW JERSEY

430

Watch for these "handbook" articles

Diesel data—200 plants—June.

Engineering data on 400 modern steam and hydroelectric plants—September.

Principles and practice of combustion—December.

It Pays You to Read POWER Regularly

New Bulletins

BOILERS AND ACCESSORIES

1 DUST COLLECTORS—Buell Engrg Co, 70 Pine St, New York, N. Y. 8-page booklet gives the case of fractional vs over-all efficiency guarantees for dust collectors. Measurement of dust particles explained, efficiency curves charted, and conclusions drawn from experiments.

2 COMBUSTION CONTROL—Republic Flow Meters Co, Chicago, Ill. 88-page data book No. S-21 covers automatic combustion control for all sizes and types of boiler, all types of fuel firing and all load conditions. Data is made up of literature concerning actual installations, giving operating data on Republic-Smoot units.

3 REFRACTORIES — Mullite Refractories Co, 2525 Clyburn Ave, Chicago, Ill. 50-page catalog describes "Shamva Mullite", and concerns itself with typical applications for boilers, furnaces, etc. Complete line of air- and heat-setting cements also described.

4 INSULATION—Ehret Magnesia Mfg Co, Valley Forge, Pa. 260-page manual consists of technical information on insulations, heat insulations, cold insulations, insulation accessories and fireproofing materials, pre-sealed insulated pipe, insulation recommendations and specification forms, refractory cement, valley-forge packings, building insulations and materials. Also asbestos fibres and textiles, useful data on heat losses, thermal expansion of pipes, conversion tables, saturated-steam table, superheated-steam table, weights, measures, and general index.

5 AIR PREHEATER—Air Preheater Corp, 60 E 42nd St, New York, N. Y. 20-page booklet describes Ljungstrom air preheater, illustrating unit, and showing by cross-section drawings applications in plant.

6 SCALE REMOVER—American Sand-Banum Co, 9 Rockefeller Plaza, New York, N. Y. 16-page booklet describes Sand-Banum compound, giving advantages, features, and operating characteristics. Chemical content also analyzed and method of application explained.

6-A SCALE PREVENTION—Activator Process Sales Co, 501 South Marengo Ave, Alhambra, Calif. 4-page bulletin describes APSCO scale-prevention service, giving points of efficiency, method of testing performance, and general description of operations.

ELECTRICAL EQUIPMENT

7 AUTOMATIC SYNCHRONIZER — Burlington Instrument Co, Burlington, Iowa. 4-page bulletin No. SN-1 gives the principle of operation of the synchronizer, together with curves illustrating proper and improper conditions for synchronizing.

8 POTENTIOMETERS — Leeds & Northrup Co, Stenton Ave, Philadelphia, Pa. 24-page illustrated catalog covers Type K potentiometers and accessories, showing principles of operation and various applications.

9 CLAMP AMMETER—Columbia Electric Mfg Co, Cleveland, Ohio. 6-page bulletin, Section 400 pictures applications of Tong-Test ammeter and gives dial ranges found on different instruments.

AIR CONDITIONING & REFRIGERATION

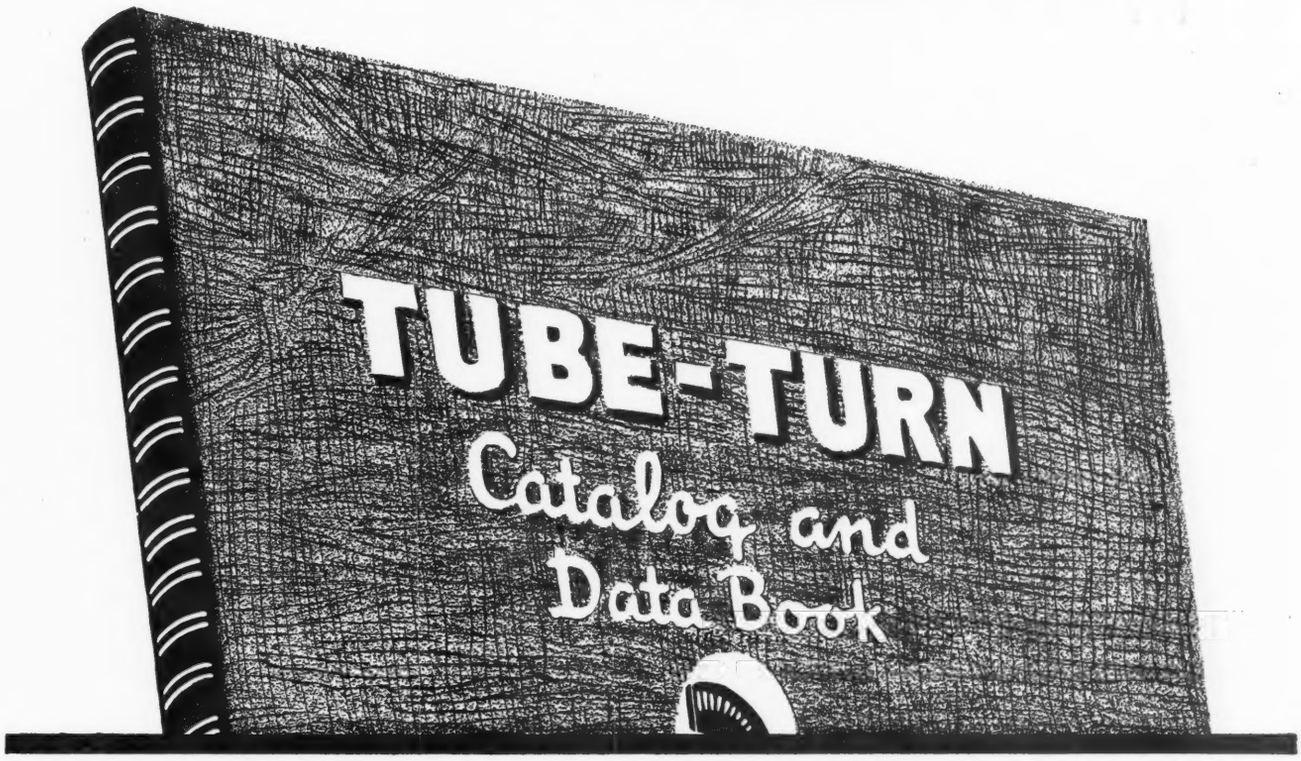
10 COMPRESSORS—De Laval Steam Turbine Co, Trenton, N. J. 52-page catalog on centrifugal blowers and compressors contains information on construction with characteristics, turbine and motor drives, properties of gases and laws of compression, and a section on calculating pressure drop in piping.

11 FANS—Wagner Electric Co, 6400 Plymouth Ave, St. Louis, Mo. 18-page bulletin on air circulating and ventilating equipment, discusses where and how to use this equipment for both cooling and ventilating purposes.

12 UNIT COOLERS—Trane Co, La-Crosse, Wis. 76-page catalog No. D-303-2 gives complete descriptions of all unit coolers and conditioners made by company. Includes capacity data, as well as cooling-coil capacity and heat-transfer properties.

13 COMPRESSORS—Frick Co, 325 Broadway, Waynesboro, Pa. 16-page bulletin No. 651-A gives applications,

GET YOUR FREE COPY!



Now!—a complete DATA BOOK for the designer and user of WELDED PIPING!

Every designer of piping systems—every buyer of pipe and fittings—will find the answer to almost every possible question about welding fittings and forged steel flanges, in this *one* Catalog and Data Book!

It contains illustrations, tables, drawings, charts on such important subjects as the design of expansion loops, flow of fluids, properties of pipe, etc.—full information regarding the new Schedule Number Method of designating pipe wall thicknesses—all important dimensions, weights, tolerances and prices on all types of welding fittings—complete data on forged steel flanges in accordance with the new 1939 Standard—

—in short, the new Tube-Turn Catalog and Data Book No. 109 is 64 pages of the most complete and helpful data *ever published* for the buyer and user of welding fittings!

Mail the coupon for your copy! Your request will not obligate you in any way.

Mail this today!

TUBE-TURNS, *Incorporated*
226 E. Broadway, Louisville, Ky.

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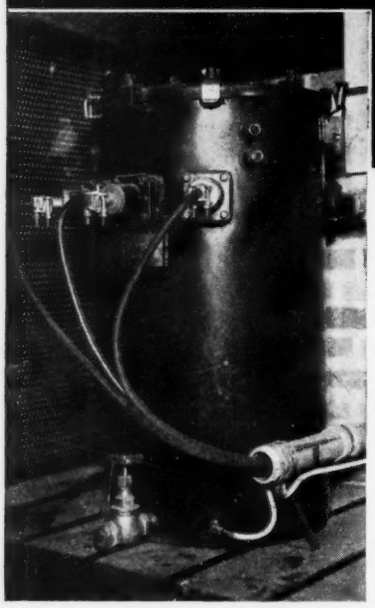
YOU GET *Triple* SAVINGS



Profitable investment for Cranberry Canners, Inc., of South Hampton, Mass.—a 25-kva Pyranol transformer installed indoors *near the load center without a vault*

WITH G-E PYRANOL TRANSFORMERS INSTALLED INDOORS *at Load Centers*

You cut installation costs

1. Pyranol transformers can be installed anywhere in the plant *without a vault* because Pyranol, the cooling and insulating liquid with which they are filled, is noninflammable.

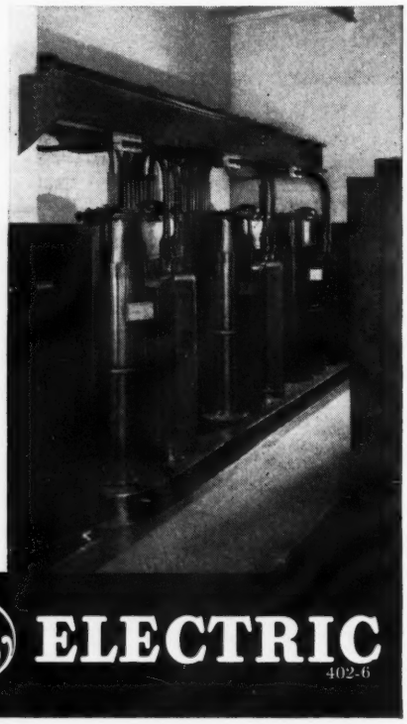
You reduce power-distribution losses

2. By installing Pyranol transformers right at load centers—even on overhead platforms if floor space is at a premium—you eliminate the need of long, expensive secondary feeders and cut copper losses to the minimum.

You save on maintenance

3. Because Pyranol is nonsludging and because Pyranol transformers are built with pressure-tight tanks to prevent evaporation and contamination, maintenance is much less than on oil-filled transformers.

It will pay you to investigate the possibilities of economical load-center distribution with Pyranol transformers. Ask your G-E representative for complete information, or write for Bulletin GEA-2637. General Electric Company, Schenectady, N. Y.



These 200-kva Pyranol transformers are installed in the motor room of the new cold-mill addition to the McLouth Steel Corporation plant, Detroit, Mich. They meant savings in installation costs, feeder costs, and copper losses, because *primary power was brought right to the load*

GENERAL ELECTRIC

402-6

52 WELDING RODS — Dymonhard Corp of America, 250 57th St, New York, N. Y. 6-page bulletin describes Dymonhard facing rods, giving principal facts concerning their use.

53 WELDING NECKS—Lenape Hydraulic Pressing & Forging Co, West Chester, Pa. 42-page catalog lists all "Red Man" products made by company, including welding necks, nozzles and manholes for pressure vessels, manhole necks and covers, and elliptical fittings, saddles rings and flange products.

OTHER EQUIPMENT

54 METAL SPRAY—Master Metal Spray, Inc, 2527 Magnolia St, Oakland, Calif. 4-page bulletin describes new Speedmaster metal-spray gun, showing advantages and method of operation. Also covers Stevens Moisture Separator.

55 OIL FILTER—Goulds Pumps, Inc, Seneca Falls, N. Y. 4-page folder describes Gould fullers-earth filter combined with a centrifuge. Flow diagrams are included, ratings and prices are listed.

56 COATING PROCESS—Metallizing Engrg Co, Inc, 21–07 41st Ave, Long Island City, N. Y. 8-page bulletin tells what metals can be "Metcolized", what equipment can be treated, and reports of results from various users.

57 PACKINGS—France Packing Co, Tacony, Philadelphia, Pa. Catalog M shows various designs of metal packing for piston rods and stems in any type engine, pump or compressor, and lists improved types of France packing for oil, gas, refrigeration, and general use.

58 OILS—E F Houghton & Co, Somerset St, Philadelphia, Pa. 4-page booklet No. 2-148 covers E P gear oils, their characteristics, applications, and physical properties.

59 DIRECTORY—Allis-Chalmers Mfg Co, Milwaukee, Wis. 34-page booklet is complete directory of engineering literature, bulletins and different products issued by company. Includes about 280 different items on power, electrical and industrial machines.

60 METALS & ALLOYS—Babcock & Wilcox Tube Co, 85 Liberty St, New York, N. Y. Technical Bulletin 12-A contains revised information and technical data on B&W seamless alloy tubes and pipe for high-pressure and temperature services.

61 LIME AND RUST REMOVER—American Chemical Paint Co, Ambler, Pa. 6-page leaflet describes Clorodine lime and rust remover, which is inhibited muriatic acid solution. Method of cleaning several types of equipment described.

62 UNDERGROUND STEAM CONDUIT — Ric-wiL Co, Cleveland, Ohio. Catalog 40 includes cut-away illustrations, as well as cross-section details and specifications of wide variety of types, designs, materials and insulation for underground steam construction.

63 GREASE CUPS—Hunter Pressed Steel Co, Lansdale, Pa. 8-page folder describes and illustrates Hunter grease cups and oil containers together with brief instruction on their use.

64 CONDENSER REPAIRS—C & C Corp, 381 Fourth Ave, New York, N. Y. 6-page folder describes new methods of repairing condenser tubes by stretching. Pictures illustrate method, and text gives advantages.

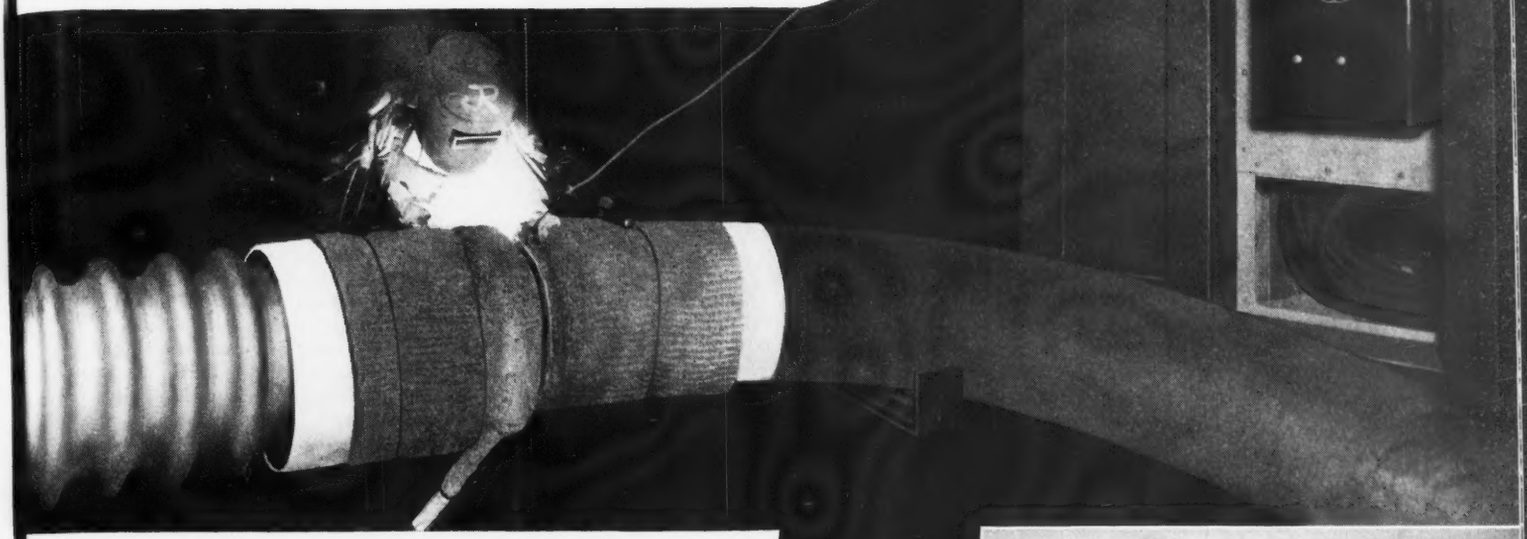
65 PACKING—Sea-Ro Packing Co, 75 West St, New York, N. Y. 4-page mailing piece describes armored nek-seal packing in ring and spiral form, giving advantages and applications.

66 GASKETS—Goetze Gasket & Packing Co, New Brunswick, N. J. 4-page folder describes all types of gaskets and gives symbol used for each one, showing cross-section and explaining construction.

67 PACKINGS—Belmont Packing & Rubber Co, Butler & Sepviva Sts, Philadelphia, Pa. 84-page catalog No. 40, illustrates and describes complete line of Belmont products, including packings of all types, sizes, and for different services. Also has section covering miscellaneous engineering data.

68 WIRE & CABLE DATA—Simplex Wire & Cable Co, 79 Sidney St, Cambridge, Mass. Simplex Manual contains data and tables for electrical engineers, contractors, wiremen, and other engineers. Includes descriptions of Simplex products, and such tables showing current carrying capacities of various wires, cable engineering data and miscellaneous mathematical tables. 270 pages.

Accurate Control
OF WELDING PROCEDURE



. . . THAT GOES BEYOND THE ACCEPTED REQUIREMENTS FOR

Piping Fabrication

In the fabrication of high pressure, high temperature piping, workmanship of the highest quality is essential to the safety of operation. Accurate control of the welding procedure, both in the shop and in the field, coupled with research in our own metallurgical laboratory assures the quality of Pittsburgh Piping fabrication.

For example, in the top illustration a qualified welder is joining a 14″ carbon-molybdenum corrugated tangent to a plain bend of similar pipe. The areas adjacent to the weld are electrically preheated by means of coils to a temperature of 500°F and this temperature is maintained during the entire welding operation. The weld is then locally stress relieved by a similar method. Note the temperature indicating and control instruments at the right that automatically maintain the desired temperature with a high degree of accuracy.

At Pittsburgh Piping & Equipment Co., control of the welding procedure goes even further. Tests of all welders' work are made regularly. For example, the above unretouched photograph showing polished carbon-molybdenum weld test samples made for our laboratory conclusively illustrates that the weld metal is as ductile and stronger than the original metal.

With welding playing such a major part in modern high pressure, high temperature piping fabrication, the accurate control of its procedure is of utmost importance; and these tests, which far surpass the requirements of the ASME Boiler Code for Piping Welding as well as the requirements of the ASME Code for Pressure Piping, are characteristic of the thoroughness of the metallurgical work at Pittsburgh Piping & Equipment Co.

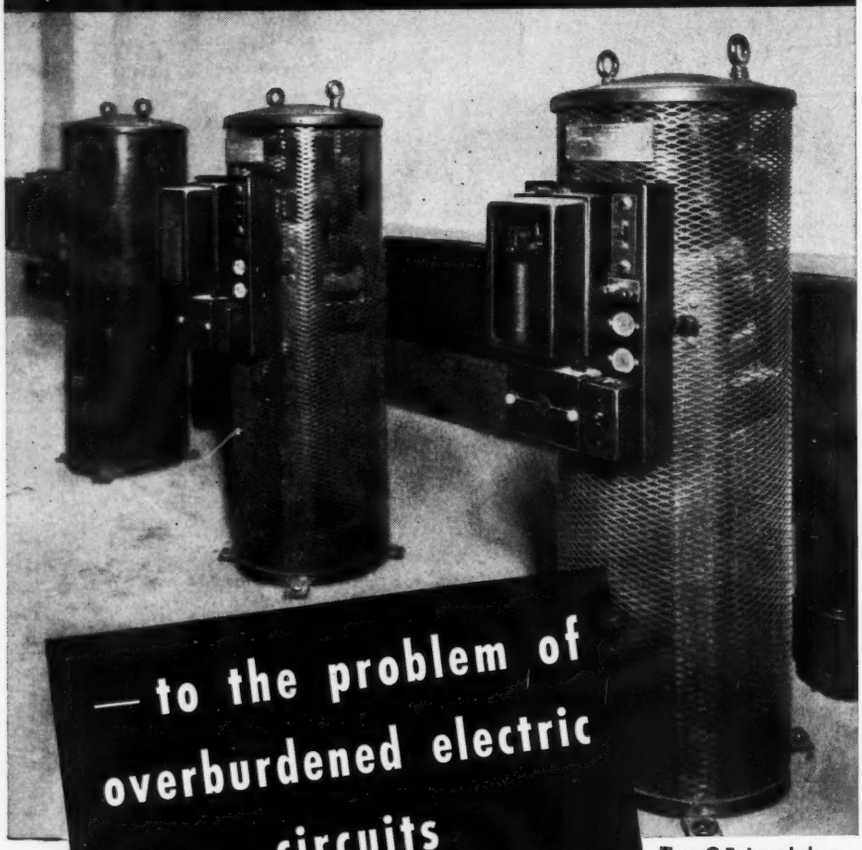
PITTSBURGH PIPING & EQUIPMENT CO., 10 FORTY-THIRD ST., PITTSBURGH, PA.

Woolworth Building, New York — Occidental Building, Indianapolis — Peoples Gas Building, Chicago — Union Guardian Building, Detroit

Public Square Building, Cleveland — 1st National Bank Building, Charlotte — 10 High Street, Boston — 525 Market Street, San Francisco

Pittsburgh Piping

Here's the ECONOMICAL ANSWER



— to the problem of overburdened electric circuits

These G-E air-cooled regulators assure proper voltage on a lighting circuit in mill of Hanes Hosiery Mills Company, Winston-Salem, N. C.

IF YOUR motors are sluggish—if your lights don't seem to have the brilliance they should, then the chances are your power-distribution system has a bad case of undervoltage. And it's ten to one that the most economical, effective remedy is to install one of our new industrial-type voltage regulators.

These regulators—Type AIRS—automatically maintain the proper voltage, thus keeping lamps and motors operating at peak efficiency and contributing to increased production.

Type AIRS regulators are easy to install—they're air-cooled and require no fireproof enclosing vault. You can put them anywhere, even on overhead platforms if floor space is at a premium. They're available for circuits from 120 to 600 volts, in ratings from 1.2 to 12 kva.

Ask your G-E representative for complete information or write today for Bulletin GEA-3057. Address General Electric, Schenectady, N. Y.

A Few of the Industries Already Using These Profit-building Regulators

Oil refineries	Testing laboratories
Chemical plants	Construction contractors
Foundries	Glass manufacturers
Oil pipe lines	Radio manufacturers
Radio stations	Refrigerator manufacturers
Lamp manufacturers	Valve manufacturers

Special AIRS regulators can be used to control current, temperature, or any other variable which can be made to depend upon voltage.

GENERAL ELECTRIC

404-6

Readers' Problems

(Continued from page 106)

operators of some sort often eliminates any choice as to which way the valve could be installed.

Jersey City, N. J. I S CHAMBERLAIN

Can Install Either Way

IN USING GLOBE VALVES in feed lines, install them so they close against the flow of water. When flow ceases, the valve tends to close from boiler pressure and, in case the disk comes off the stem, the flow will hold it open as long as there is feed, and boiler pressure will close it when the feed stops. With water lines subject to vibration it is a good idea to have pressure above the disk so that, when closed, the pressure tends to keep the disk tight against the seat and prevents vibration from opening the valve.

For most situations, and particularly for large valves or high pressures, it is preferable to have pressure under the disk as this permits packing the valve when closed and prevents the stem pulling out of the disk when the valve is opened. Also, when the line cools down with the valve closed, the lost motion between disk and spindle permits the disk to follow the contraction of the valve body and when steam is again turned into the line, the valve is as tight as before. If steam were reintroduced on the seat side of the valve, there would be leakage until the valve got reheated and re-expanded to its former dimensions, and to close a valve down tight before it is warmed up makes it harder to open after the expansion takes place.

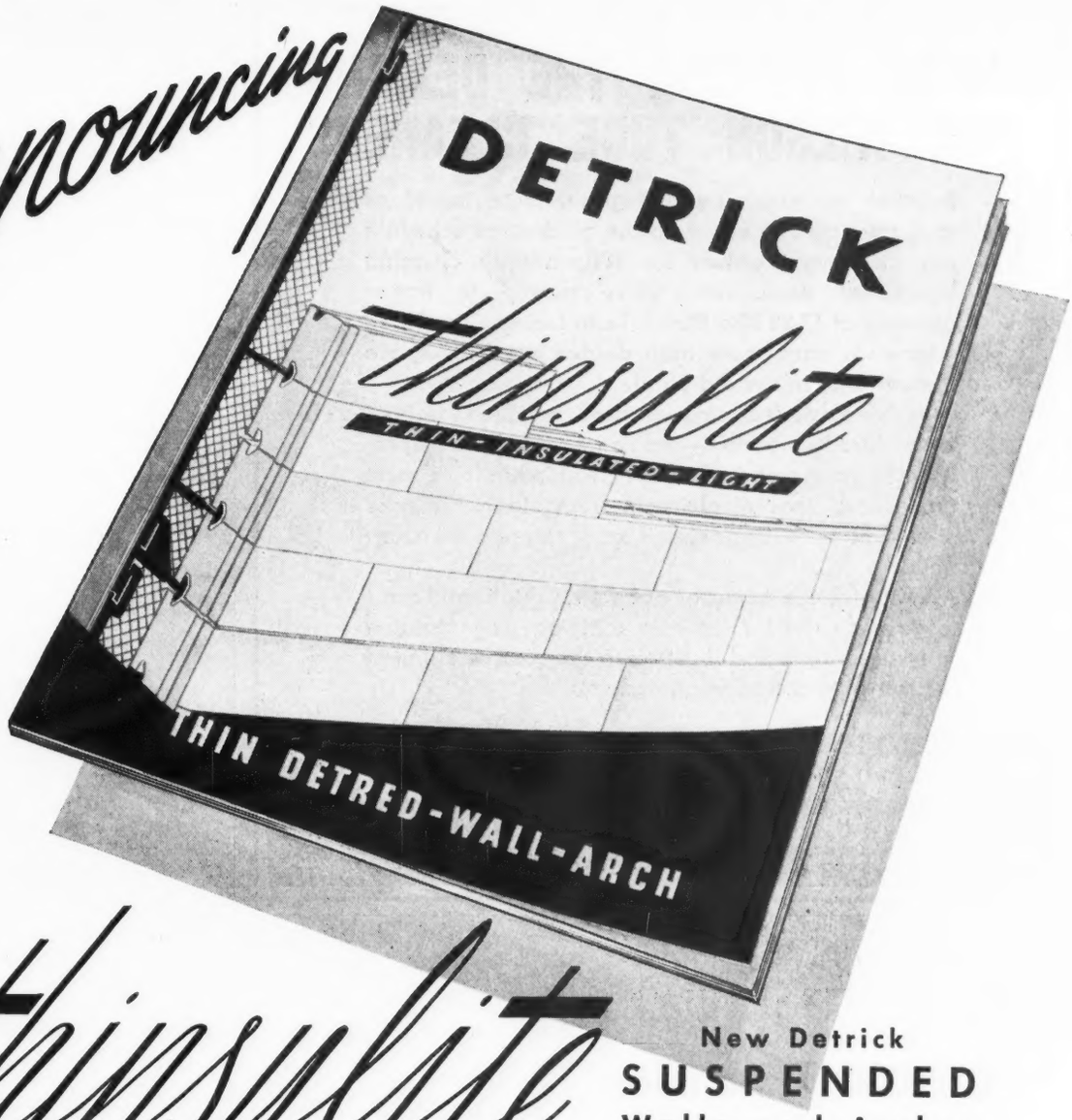
Philadelphia, Pa. W T MULLEN

Pressure Below Best

THE QUESTION of installing globe valves comes up for discussion many times in our plant—here are some of our answers: On steam lines where the valve is normally open we place the valve with pressure below the disk so the flow would force the disk up and, if the stem should break or vibration have a tendency to close the valve, pressure would prevent it. For valves normally closed or used several times daily (on soot blowers, or for water-column blowdown), we like pressure above the disk. Pressure helps force the disk down, eliminating the need for turning the valve wheel extremely hard to prevent leakage. Occasionally a stem or disk breaks from turning up too tight.

For valves controlling admission of steam to a prime mover we prefer pressure under the disk, for if the valve were closed tightly and the machine didn't run for long periods of time, the valve might stick so that pressure from below would be helpful in opening it. This is particularly important on equipment used for standby where delay in opening a stuck valve might be disastrous. Of course,

Announcing



thinsulite

THIN—INSULATED—LIGHT

New Detrick
SUSPENDED
Walls and Arches that compete with Solid Wall Construction!

By combining thin refractories . . . insulation . . . and the Detrick SUSPENDED tile principle, we can now offer Detrick efficiency at a first cost that definitely competes with solid wall construction.

Complete *suspended* enclosures are now possible, using THINSULITE construction in combination with the regular Detrick DETRED construction in the hotter zones. Suitable for Boiler Walls, Water Wall Backing, Oil Still Furnaces, Stress Relieving Furnaces . . . in fact, all areas not exposed to actual abrasion. Advantages are: low material and labor cost . . . light weight . . . low heat loss . . . permanent heat tight and air tight structure . . . and therefore low maintenance cost.

Be sure to get your copy of this new Detrick THINSULATE Catalog . . . free on request . . . showing construction, applications and heat transfer curves on this new Detrick engineering achievement.

DETRICK INSULATION
Made by DETRICK
For every Heat Insulation requirement Detrick offers many distinct advantages.
BLOCK
BLANKET
PLASTIC
CONSULT US ON INSULATION PROBLEMS
Pioneers of Furnace Engineering and Insulation

M.H.DETRICK COMPANY

Since 1913

140 SOUTH DEARBORN STREET • CHICAGO, ILLINOIS

WE'RE MEETING THE DEMAND FOR WILSON TUBE CLEANERS

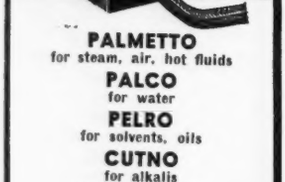
Because we needed more space, more machines and more men to maintain the production schedule our customers' orders for Wilson tube cleaning equipment demanded, we've moved to larger quarters at 47-28 37th Street, Long Island City, N. Y., where we have more than double the floor space that we had in our old plant.

We've installed several new machine tools — we've hired more men—we've increased our capacity and now can make *prompt* shipments of most types and sizes of cleaners from stock. Special sizes can be manufactured and shipped on short notice.

Write for the name of our representative nearest to you or send for our new thirty-six page catalog fully describing and illustrating the complete line of Wilson tube cleaning equipment.

THOMAS C. WILSON, Inc.
PIPE AND TUBE CLEANERS EXCLUSIVELY
47-28 37th Street Long Island City, N. Y.

ONE SIZE PACKING THAT FITS ALL SIZE VALVES



PALMETTO
for steam, air, hot fluids
PALCO
for water
PELRO
for solvents, oils
CUTNO
for alkalis
SUPER CUTNO
for acids

Every thread and strand of PALMETTO Twisted Packing is a complete packing in itself, long fibre asbestos, thoroughly impregnated with a special lubricant that keeps it soft and reduces friction and wear. Unstranding the packing gives you the desired size for small valves. Plaited and braided types are available for other purposes.

FREE TEST SAMPLE

Send for a sample of Greene, Tweed Packing to test in service. We base our claim for your business on tightness, length of life and minimized shaft wear.

GREENE, TWEED
SELF-LUBRICATING
PACKINGS

GREENE, TWEED & CO., 101 Park Ave., New York, N. Y.

where the prime-mover valve has an overspeed-stop mechanism, the valve must be installed to function according to this construction, usually with the pressure above the disk so flow forces the disk to seat when the overspeed trips.

On air lines we install valves with pressure below the disk. With pressure above, the glands may leak and allow pressure in the air receiver to drop slowly. In fuel or gas lines, pressure below the disk prevents fuel from leaking through packing glands and vaporizing. In some cases this might create a fire or explosion hazard.

In most cases, or when in doubt, I think it best policy to install valves with pressure under the disk as this gives less packing-gland maintenance and less leakage loss from glands.

Bismarck, N. D. LESLIE BRADLEY

Current Comment

Condenser Scale

IN HIS ARTICLE "Station K Wins Battle Against Condenser Scale", pages 84-85 of March POWER, Mr John O Olson has presented results obtained in the elimination of condenser scale by treating a difficult water with 1 or 2 ppm of sodium hexametaphosphate. This procedure of applying such minimal amounts of hexametaphosphate—or others of the molecularly dehydrated phosphates, such as pyrophosphate, or the "polyphosphates" glassy or crystalline, intermediate in composition between metaphosphate and pyrophosphate —is "Threshold Treatment".

The discovery of "Threshold Treatment" by Dr Ludwig Rosenstein occurred in a field quite foreign to power-plant operation. His promotion was to prevent scale formation in irrigation lines supplied with hard water into which ammonia was injected for fertilization purposes. In searching for an economical solution to the problem, Dr Rosenstein ran through the gamut of possibilities: the tannins, starches, alginates, hay infusions, and so forth, finally finding in the molecularly dehydrated phosphates in general and sodium hexametaphosphate in particular the answer which is his company's regular procedure today. This work by Dr Rosenstein is embodied in his U.S. Patent Reissue 20754 assigned to the Hagan Corporation of Pittsburgh.

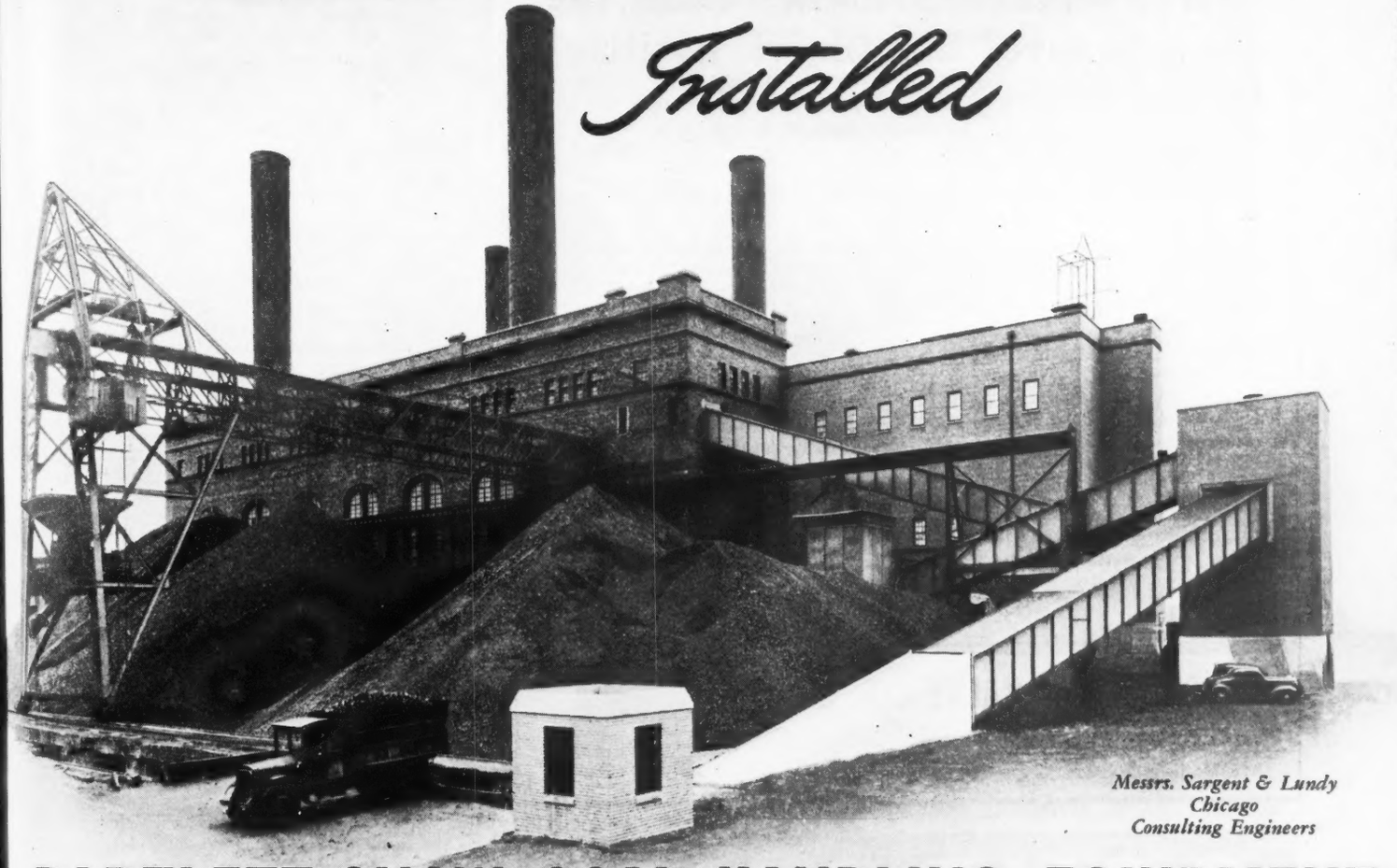
The great majority of our natural waters are characterized by bicarbonate or temporary hardness. Whenever the bicarbonate equilibrium is disturbed, e g, by rise in temperature or by change in pH value, deposition of calcium carbonate scale follows. Thus, Rosenstein's solution of his irrigation problem led him to evolve principles of much broader application, extending among others to all heat-exchange systems, using cooling water, and to all treated-water systems, municipal or industrial.

Mr Olson has nicely demonstrated threshold treatment in one type of heat-exchange system and over a sufficient period to be very convincing.

Pittsburgh, Pa. R E HALL
Director, Hall Laboratories, Inc

CINCINNATI GAS and ELECTRIC

Installed



Messrs. Sargent & Lundy
Chicago
Consulting Engineers

BARTLETT-SNOW COAL HANDLING EQUIPMENT

● Complete with a receiving hopper, that is loaded by truck and discharged with a duplex reciprocating feeder, five belt conveyors having 176; 154; 49; 118; and 35 foot centers respectively, a coal crusher, magnetic pulley, belt tripper, a 72 foot reversing shuttle belt that discharges into any part of a bunker twice its length, and a coal reclaiming system, the Bartlett-Snow equipment at Cincinnati—like other Bartlett-Snow installations—has met fully the customer's requirements.

Designed by men who do now—and have for years—devoted their entire activity to coal handling problems . . and fabricated to Bartlett-Snow's nationally recognized standards in our own machine and structural shops under the exacting inspection of the designers themselves instead of being jobbed out to other fabricators—Bartlett-Snow equipment is ideally suited to the individual requirement . . . and in addition, reflects the many refinements and niceties of design and fabrication that promote efficient and trouble-free operation in service.

That is why you'll find Bartlett-Snow coal handling equipment being selected in preference to other equipment by many of the best known and most representative central stations—and large, medium and small industrial boiler plants alike . . . It meets the need more accurately and works better. More complete information including illustrations of recent installations, equipment details, etc., are contained in a 48 page bulletin, copies of which will be sent on request. Send for your bulletin today.

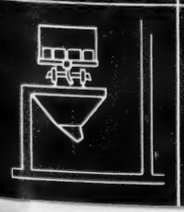
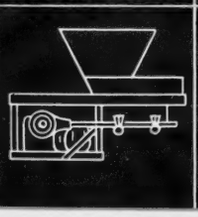
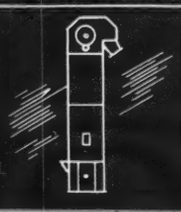
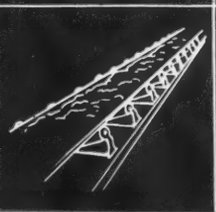
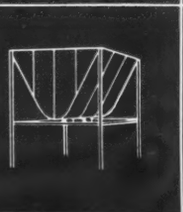
THE C. O. BARTLETT & SNOW COMPANY

New York • Chicago • **CLEVELAND, OHIO** • Baltimore • Des Moines

BARTLETT-SNOW

• • BOILER PLANT COAL HANDLING SYSTEMS • •

Complete Engineering and Fabricating Facilities to Meet Any Requirement Including

Track Hoppers	Gates and Feeders	Skip Hoists	Bucket Elevators	Belt Conveyors	Bins and Bunkers	Weigh Larries
						

WHY WASTE STEAM, when the cry is to save? Use CRYER positive-acting Steam Traps instead

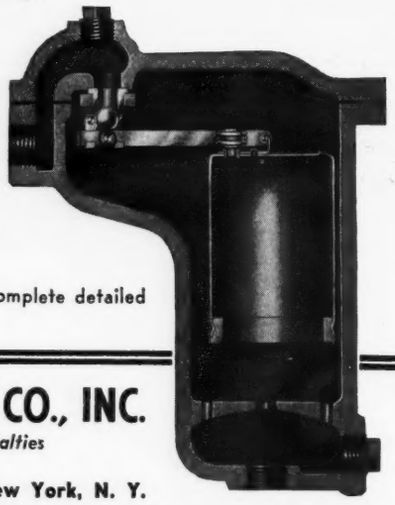
This quick-venting all-purpose trap is designed to eliminate air-binding and is guaranteed for performance.

Install a CRYER and it will pay for itself quickly in steam savings and through increased efficiency in steam distribution.

All mechanism is removable without disturbing piping, saving maintenance—all wearing parts of stainless steel, insuring the maximum in life and the minimum in repairs—installation is simple, requiring no special supports—venting is quick and positive, assuring fast action and dependable drainage.

AIR TRAPS for draining water from air lines will be furnished with quick venting valve omitted.

These and other advantages—in fact all time and money saving features you look for in a steam trap are offered in the CRYER INVERTED BUCKET STEAM TRAP—available in sizes from ½" to 2½", and in capacities from 500 to 38,000 pounds of water at pressures from 0 to 250 pounds.



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AIR COMPRESSORS

1—Save in space—Schramm Compressors are of compact, vertical design.
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Get all details today. Write for a copy of Bulletin No. 3907.

Schramm Compressors are available in a wide range of sizes for direct motor drive, belt drive or engine drive. There's a size and type to meet your needs.

SCHRAMM, INC., WEST CHESTER, PA.
ESTABLISHED, 1900

Smoke Abatement

THIS IS A NOTE of appreciation for your editorial "Common Sense in Smoke Prevention", March POWER. I think this is specially good. From the standpoint of the ASME and the Model Smoke Law Committee, it helps us out in our arguments with the people concerned about large stacks.

The only thing I would take issue with is the first sentence in the second paragraph, "Engineers will grant that almost any coal can be burned without black smoke, given correctly designed equipment and a wide-awake operator." A person might infer from this statement that all smoke came from burning coal. We get plenty of smoke from oil, wood, rubbish and various other fuels. I think it would be better to say fuel instead of coal.

Jersey City, N. J. WM G CHRISTY
Smoke Abatement Engineer

How to Turn a Boy Into an Engineer

THE TIME HAS COME for industry everywhere to face its job of training young men to fill responsible positions as engineers and as skilled craftsmen. Take the power plant, for example. Where will the competent operating engineer for the future come from? From today's boys who get the right experience, plus the right schooling, and get them both young.

As far as power experience is concerned, the apprentice will generally learn faster in the small industrial plant, if such plant be up to date, than in the large central station. In the small plant the chief engineer himself is often a topnotch mechanic. He is not specialized in any one line. He operates (or oversees the operation of) boilers, pumps, generators, turbines, switchboards, air compressors—often refrigerating and air-conditioning machinery, as well. He usually keeps his own records and may do much of his own repair work.

The young fellow seeking competence as a power engineer can't do better than get a job as assistant, helper, or general-utility man in such a plant. It will give him a chance to learn the mechanics of power-plant operation from A to Z.

Add a little theory to this practical training and you have another good engineer in the making. Most large cities have good night schools where the boys can pick up the essential elements of a technical education.

How much time should be allowed for this first step in the engineer's career? It will vary, of course, with conditions. However, if the young man really wants to know, and if his immediate superior is willing to teach him, four or five years of this general-utility experience, plus night school, should be enough.

This boy is now at the stage where he still doesn't know it all, but imagines that he does. No need to lecture him about this; just put him in charge of a shift and he'll find out soon enough. His first few shifts as an operating engineer will live long in his memory. The very hum of the plant's machinery sounds different

TONG TEST

the only clamp-type ammeter

WHICH MEASURES BOTH A. C. AND D. C.

Obviously, a plant engineer would prefer to measure currents with a Tong Test Ammeter which makes any reading instantly, accurately and without breaking the circuit rather than to tie-up production for an indefinite length of time. Tong Test is the only instrument of its type which can do this in the plant having both A. C. and D. C.

Three exclusive features are responsible for Tong Test's greater usefulness and unfailing dependability. They are:

1. Only Tong Test measures both A. C. and D. C.
2. Tong Test can not burn out under overload because it is the only instrument of its kind which contains no windings.
3. Only Tong Test is furnished with a set of individual scale ranges to meet your exact needs. Instantly interchangeable and with only one set of large numerals on each, the scales are more easily and more accurately read.

Tong Tests are made in eight standard ranges for measuring up to 800 amperes A. C. and 400 amperes D. C. May we send you all the facts about the Tong Test or arrange so you can try the instrument itself?

COLUMBIA ELECTRIC MFG. CO.
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OTHER COLUMBIA PRODUCTS

A. C. GENERATORS
1 TO 300 KVA

SPEEDS: 1800, 1200, 900, 720, 600, 514, 450 R.P.M.
Direct Connected or Belted Exciters

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SYNCHRONOUS MOTORS—PLATING GENERATORS
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A. C. Generator with Belted Exciter

YARWAY
INVOLUTE
SPRAY
NOZZLES

Unique Yarway Involute design.

No internal parts or vanes to clog or erode.

Unobstructed flow gives minimum loss of head.

Finely divided spray cone provides rapid cooling.

Renewable orifices adapt nozzles for any service.

Installations total more than 5 million gallons per minute in water cooling and air conditioning service.

Made in both cast and bar-stock types. All sizes from 1/4 in. to 2 1/2 in. Write for Catalog N-615.

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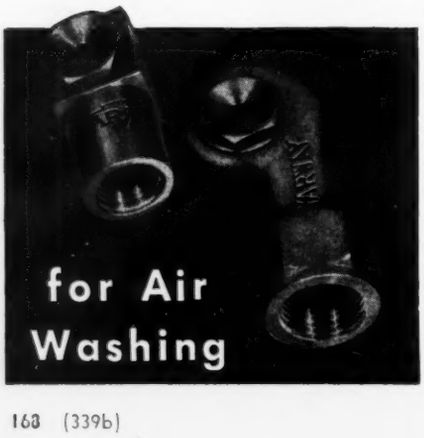


when he can no longer depend on old Bill's trained ear and must use his own.

He may be lucky and sail along smoothly for a few days, but Old Man Trouble is always lurking behind the door. Sooner or later he will walk in and out again, leaving the new "engineer" wild-eyed and shaky.

These are the days of testing and super-education. If the young man has the right stuff in him, he collects his wits and tackles his troubles. It is then that his five years of training stand him in good stead.

The months roll by. He meets and overcomes one difficulty, then others, until finally most of them are just part of the day's work. Then he acquires self-confidence that is not the over-confidence he had when he completed his apprenticeship, but a well-grounded trust in his own true ability. When he reaches that stage he's an engineer.

Rochester, N. Y. H P KING

Hospital Steam

CONGRATULATIONS on the splendid article, "Hospital Power Plants Need a Doctor," page 60, December POWER. In a great many cases hospital power plants unquestionably need a doctor and such a man should be a well trained diagnostician in matters quite foreign to the medical profession.

Here's an added thought. If a hospital operates its own laundry, a high-pressure boiler plant becomes necessary. This supplies, also, heating steam and hot water. The same boilers could handle the power load as well, yet scores of hospitals purchase light and power produced in another boiler plant miles away. It requires no imagination to see that two steam boiler plants will cost more than one.

Why should the hospital operate its own boiler plant continuously, and then go to a distant boiler plant to obtain its electricity? This is particularly extravagant in cases where the hospital has a suitable boiler and maintains a crew to keep it in continuous operation.

No well-managed hospital would operate one boiler plant, for its high-pressure steam and another for its low-pressure steam. Combining the washing and the ironing in the same laundry is highly economical. Combining the heat and power loads on the same boiler plant is likewise economical. The steam demand for building heat and laundry is generally far in excess of the steam required to pull the top electric load.

If hospitals are short of funds, why should they neglect such easy means of saving substantial amounts of money by a little well-organized planning? Indeed, hospital power plants need a doctor.

Bloomfield, N. J. EGBERT DOUGLAS
Consulting Engineer

Work With Tools

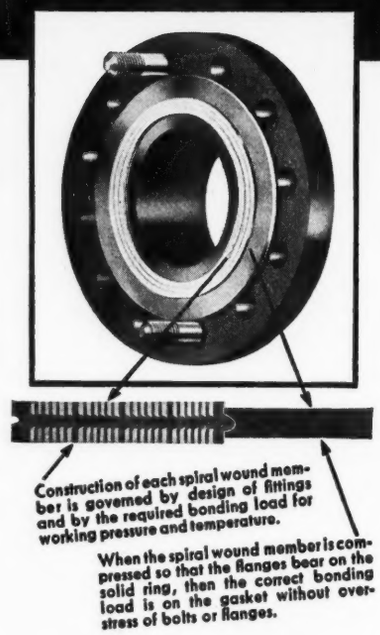
WILLIAM MCAFEE, chief marine engineer extraordinary, has spent the better part of his life in the engine rooms of ships. During this time, besides attending to his engineering duties, he managed to write and publish a number of fictional stories

FOR HIGH-PRESSURE FLANGED JOINTS
Flexitallic Style C-G Gaskets

Applicable to Raised Face, Smooth Face, Van Stone or Cranelap Fittings.

Safety and springiness contributed by a spiral wound member.

Solid metal member acts as a compression gauge and assures correct bonding load.


Construction of each spiral wound member is governed by design of fittings and by the required bonding load for working pressure and temperature.
When the spiral wound member is compressed so that the flanges bear on the solid ring, then the correct bonding load is on the gasket without overstress of bolts or flanges.

For 28 years, Flexitallic Gasket Company has anticipated demands by industry for spiral wound gaskets capable of holding increased pressures and temperatures.

The greatest improvement is the Flexitallic C-G Gasket. Its outside metal ring acts as a compression gauge, so that you know when the gasket is correctly compressed. This ring also provides complete confinement of the gasket member. Therefore, this gasket is absolutely safe.

You can replace the gasket proper using the compression ring innumerable times. This reduces your replacement cost. The gasket is easy to install, is safe, foolproof and economical.

Flexitallic Gaskets are constructed according to the engineering requirements of the individual installation.

"Flexitallic" Reg. U.S. Pat. Office

As the first step in the satisfactory solution of your gasketing problems, write on your letterhead to Dept. A for our C-G bulletin, or, better still, detail to us your gasket troubles.

Patents are pending for the Style C-G Gasket

Originators of Spiral Wound Construction

FLEXITALLIC GASKET CO.
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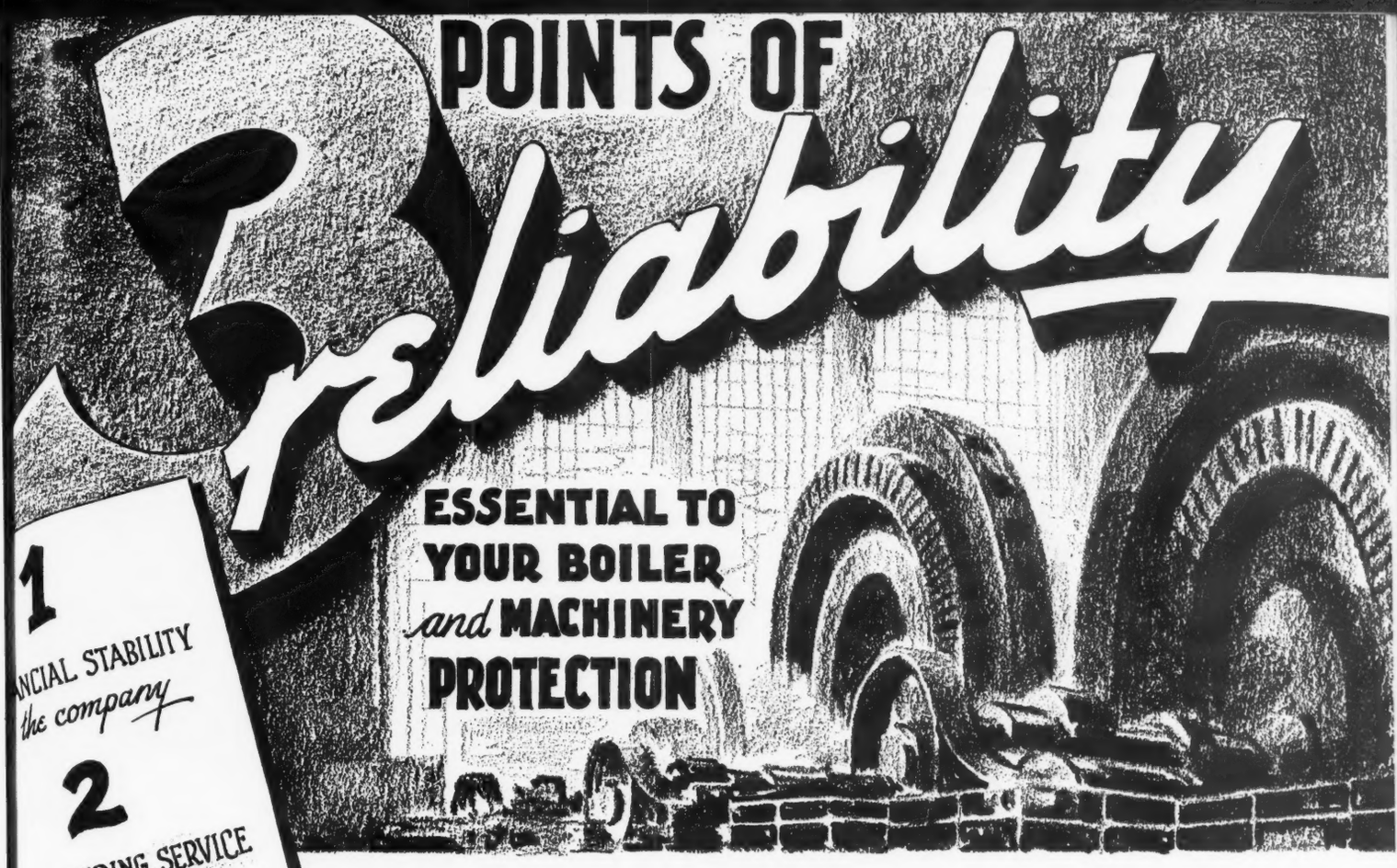

1

ANCIAL STABILITY
the company

2

ENGINEERING SERVICE
that prevents loss

3

EXACT COVERAGE
to fit
your
business

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COLUMBIA CASUALTY COMPANY

FINANCIAL STABILITY of "Ocean and Columbia" Power Plant policies is amply backed by present assets . . . by a 60 year record of never having failed to pay a just claim . . . by sound capital stock financial structure . . . by a long background of sound insurance methods . . . all of which are essential to boiler and machinery protection

ENGINEERING SERVICE is effective when it prevents accidents *before* they happen. That's where "Ocean and Columbia" experts fit into your picture. Licensed inspectors, they bring with them a rich experience gained in many types of power plants . . . backed by special training in the works of leading manufacturers. Flaws or faults that may escape the attention of plant engineers absorbed in operating problems are detected almost unfailingly by the methods, instruments, and skill of "Ocean and Columbia" experts. "Every man to his last" . . . these "Ocean and Columbia" Engineers *specialize* in the *prevention* of Boiler and Machinery failures.

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An "Ocean and Columbia" analysis of *your plant* . . . *your hazard* . . . is available without obligation.

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LOW-COST WAY TO CLEAN HEAT EXCHANGERS

Have carbonized oil deposits impaired efficiency of your heat exchangers? Then remove them now before trouble develops. But do the job easily . . . and save time and money as many other plant engineers do . . . by cleaning your exchangers the successful, low-cost Oakite way.

No dismantling necessary. Just circulate solution of recommended Oakite material through equipment as directed, then flush system. Carbonized oil or other insulating deposits are thoroughly removed. Heat transfer efficiency is restored . . . units go back in service quickly. And all this accomplished at a cost that will prove a welcome surprise to you!

Save Money ON ALL POWER PLANT MAINTENANCE JOBS

For safely de-scaling Diesel cooling systems, stripping transformers, cleaning air filters, steam cleaning and other jobs, let Oakite materials save time and money for you. Ask for specific, helpful data on your cleaning problems. No obligation.

OAKITE PRODUCTS, INC.
23 Thames Street, New York, N. Y.
Representatives in All Principal Cities of the United States and Canada.

OAKITE Certified cleaning
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

and novels. Good stories that had a punch and so full of interest that the better universities include their reading in journalistic courses.

A student of one of these courses, struck by the style and interest, wrote Mr McAfee for advice. He wanted to learn to write as well and asked for a program which would enable him to reach and perfect his own style.

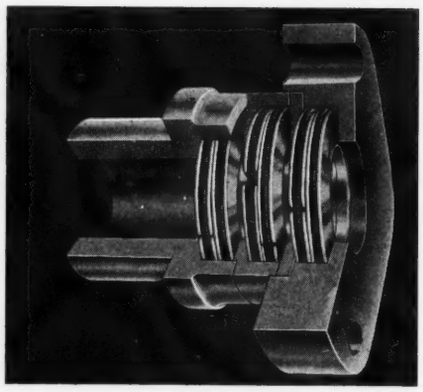
"Work with tools," Mr McAfee replied. The gist of the rest of his advice was that if a man could first learn to use his hands for mechanical work he would make a better writer. Mr McAfee ought to know for he was born in England and was required to serve a long apprenticeship in machine shops before being permitted to take an examination for a marine license. A good writer must be able to think and express his observations accurately. The best writers have at some time used their hands for hard mechanical and construction work.

This in essence is the advantage of practical training for future power-plant operators. If a young fellow can work while he is learning he will later be more apt and proficient. Study is essential but the student who has never dirtied his hands in cleaning a bilge strainer or repairing a broken machine is not capable of applying the teachings of a textbook. He may read, for instance, that a boiler to be efficient must have clean plate surfaces. But how can he be certain that the water side of a boiler is clean unless he has crawled through a manhole and inspected them.

Nowadays, it is not unusual to find men with operating licenses whose experience is limited to a few months of lubricating a dinky laundry engine. There is a tendency, since the advent of central power stations, to minimize the importance of having experienced men handle power because it is transmitted to your door. Some users feel that a watchman can turn steam on and off the heating system and manipulate the switches that distribute electric current to the various circuits. There is no need of an engineer, they reason. Anyone can open a valve and if a tenant feels too warm he will shut off his radiator. So how can steam be wasted?

In like manner they reason that motors and lights must be turned on and off regularly without regard for the total operating load. The power-demand meter is just so much Greek to them and comparisons are impossible as no records beyond the monthly bill from the utility company are available. Condensate returning from huge heating systems in buildings where steam is purchased is discharged to the sewer after being pumped through a water-mixing valve to lower the temperature. Thousands of Btus are thus wasted and many gallons of cooling water that otherwise might be diverted to some useful purpose. A good practical engineer would be thoroughly disgusted if he could not recover most of the heat from the condensate. He would have a nervous breakdown if the power-demand-meter readings exceeded the most absolute minimum load.

There is romance in engineering for the man who advances from the menial tasks to supervision of a power plant. Such



France Metal Packing, Type No. 210, has three pairs of wearing rings and is suitable for pressures up to 150 lbs. Chiefly used on small rods and valve stems. It is outstanding for its economical and efficient performance on Corliss valve stems.

France Packing SAVES MONEY

Experience acquired for nearly half a century in selecting metals and designs for France Metal Packing has provided maximum sealing efficiency with minimum expense in all types of engines, pumps and compressors, operating under any condition of speed, pressure or temperature. This experience has imparted long life as well as efficient operation—we have records of France Metal Packings that are still giving satisfactory service after *thirty-five years of constant use.* For downright packing economy, insist on France Metal Packing.

Another important feature is *simplicity of installation.* It is only necessary to see that the rings are installed as lettered to correspond with similar letters on the case. As simple as A-B-C.

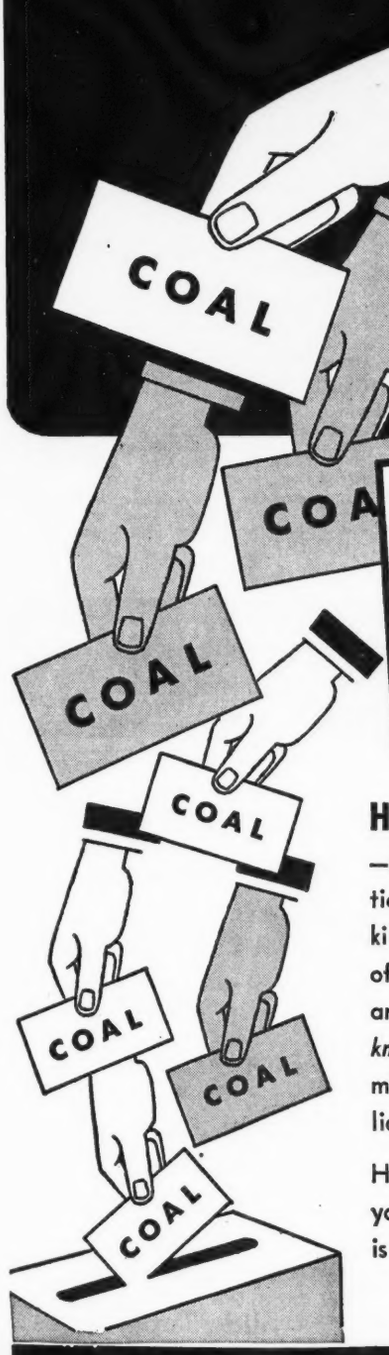
There is a qualified and experienced representative close at hand. Replacements or renewals can be obtained by furnishing the number stamped on the case and the rod diameter.

The new, profusely illustrated France Catalog M-7 is now available. Write for a copy and learn how to raise engine efficiency, reduce packing trouble and save money!

THE FRANCE PACKING COMPANY
Tacony, Philadelphia, Penna.
Branch Offices in Principal Cities

Original FRANCE METAL PACKING

Central Stations Vote 40 to 6 for COAL!



BULLETIN: Last year new high-pressure steam generating units were placed in operation, under construction, or ordered by fifty-three central stations in this country. *Forty* of these plants chose equipment to burn COAL exclusively! Seven elected to burn coal and some non-solid fuel. And only *six* out of 53 chose to operate with fuels other than coal.

HERE IS THE VOTE OF EXPERTS

—of engineers who analyze their production problem down to decimal points of a kilowatt per pound or pint or cubic foot of fuel. They check and recheck performance of equipment and fuel until they *know* they're getting maximum efficiency, minimum maintenance costs, maximum reliability and economy.

Have *you* a power or heating problem in your plant? Probably the economy answer is modern equipment burning *coal, the modern fuel*. Chesapeake and Ohio's Fuel Service Engineers will gladly help you—without charge—to make comparative cost and efficiency studies. These combustion experts can also help you secure the type of coal best suited to your needs, for Chesapeake and Ohio serves "The Coal Bin of America"—the greatest bituminous coal fields in the country. From modern mines in this area you can get coal prepared and uniformly sized to your exact specifications. You can depend, too, on this railroad for careful, quick delivery of your coal, *when* you need it, and *where* you want it.

For information or assistance with fuel problems, write GEORGE H. REINBRECHT, Coal Traffic Manager, 2901 Terminal Tower, Cleveland, Ohio.

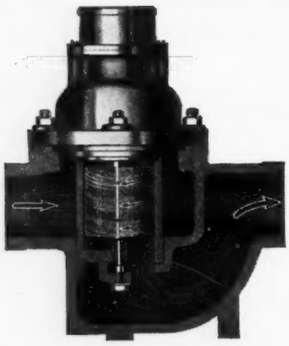
CHESAPEAKE AND OHIO LINES

HENSZEY

CONTINUOUS BLOWDOWN

Removes the Cause of The Trouble

- **NO SCALE**
- **NO PRIMING**
- **NO FOAMING**



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FEED WATER METERS

Go Right in the Feed Line

They register within 2% of absolute accuracy, regardless of the dirt or heat content of the water.

They accurately measure the pulsating discharge of reciprocating pump.

Write for FREE CATALOGS

HENSZEY COMPANY

Dept. D5,

Watertown Wisconsin

HENSZEY

a man never tires of applying an iron hand to all power leaks and inefficiencies. He can spot a Btu trying to escape from the performance of its work, push it back through the engineering mill and extract the last gram of its energy. He does not think in terms of a job to be hurriedly done and then forgotten. Every watt of electricity and Btu must be accounted for.

The practically trained man loves every nut and bolt that helps to hold together his engines and pumps. He collects them in a waste bin after the threads have been stripped and later machines them to a smaller size to be reused for a lesser task.

There is exhilaration in having the ability to operate engines and distribute power economically. There is comfort to those grown old in pleasant memories of the time a broken cylinder head was patched and the engine run until a new head could be cast. Yes, and there is satisfaction coming to an engineer when his boss who does not understand engines tells him he has done a good job and may expect a raise. Perhaps he really was not entitled to a raise. Maybe he squeezed the last ounce of economy out of his plant because he is naturally mean and miserly. However, the raise will help to pay off the mortgage on his home. It is a very old mortgage and sizeable. Money is an unfamiliar form of power to him.

New York, N. Y. W S Downs

Correction

Mr Manley H Clark, Southern Counties Gas Co of California, writes to point out that the diagram for the "high-temperature" gas-engine cooling system, published on page 79, March Power, showed steam going directly from the expansion chamber to process use. While the text referred only to process applications where heat exchangers would be used, such as tank-heating coils or unit heaters, the diagram, as released by the American Gas Association, did not clearly indicate the necessity for indirect use of the steam liberated in the expansion chamber. Direct use of this steam, and loss of condensate, requires makeup. Adding raw water leads to scale troubles in the engine jackets and adding treated water involves unnecessary complication. Where steam for direct process use is needed, Mr Clark recommends installing a heat exchanger in the expansion chamber.

The original release from the AGA gave the impression that the report on this new method of gas-engine cooling was prepared by Mr D W Reeves. Actually, Mr Reeves is chairman of the AGA Gas-Engine Power Committee; the report was written by Mr Manley H Clark.

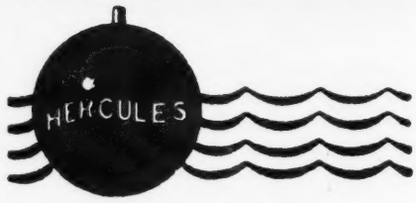
Charles M Chapman is now representing Cochrane Corp in the Cincinnati territory, covering parts of Ohio, Indiana and Kentucky. Offices are in the Schmidt bldg, Cincinnati.

Robert W Stratton has been appointed regional sales manafer for Cummins Engine Co, Columbus, Ind. His territory covers an area north of the Ohio River, and parts of Pennsylvania and New York. Headquarters are in Cleveland, Ohio.

HERCULES

Seamless Copper

FLOATS



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Every Hercules Float carries our guarantee to stand up under 350 lbs working pressure and 500 degrees temperature

Fabricated of seamless copper under our special spinning process, Hercules Floats are uniform in thickness and high in mechanical strength

You can depend on Hercules for floats in standard shapes up to 10 in and in special types to your specifications— to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES"

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Save Air—Save Dollars

With

ROCKWELL BLAST GATES

For Low Pressure Air

Butterfly Flanged Type

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Write for catalog No. 3760

W. S. ROCKWELL COMPANY

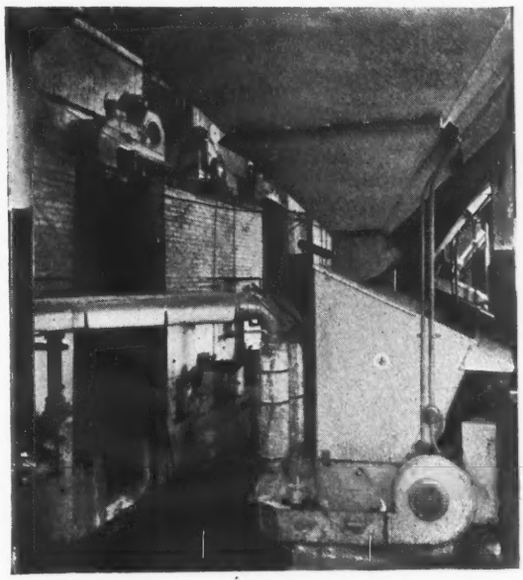
50 CHURCH ST., NEW YORK

$1200 a month SAVED

. . . after IRON FIREMAN Replaced Other Stokers in Victor Brewery

When its boilers were fired by four stokers of another make, the Victor Brewery burned coal costing $3 a ton. During peak seasons, firemen were kept constantly on duty, poking the fires in order to enable three boilers to carry the load. Also, firemen had to watch for peak loads, and prepare fires 30 to 45 minutes in advance.

Now, with Iron Fireman Pneumatic Spreader stokers installed, the Victor Brewery burns coal costing only $2.36 a ton. Even during peak seasons, no more than two boilers are fired at any one time, and firemen are instructed to clean fires but once every eight hours. No preparation is needed for peak loads; the Iron Fireman stokers pick up the load as it comes on, without steam pressure dropping. Total fuel savings are $1200 to $1500 a month.



Four Iron Fireman Pneumatic Spreader stokers firing four 396 h.p. Erie City vertical water-tube boilers, in plant of Victor Brewing Company, Jeannette, Pennsylvania

Plant of Victor Brewing Co., Jeanette, Pa. . . . where 4 Iron Fireman Pneumatic Spreaders are operating

Learn What *YOU* Can Save

There need be no guess-work about firing equipment purchases. An Iron Fireman Engineering Survey will determine accurately your possible savings and betterments. We will work with your own engineer, consulting engineer or fireman. Mail the coupon.

IRON FIREMAN

Automatic Coal Stokers

SEND FOR FREE 20-PAGE CATALOG

IRON FIREMAN MANUFACTURING CO.
Portland, Ore.; Cleveland; Toronto.
Mail to 3376 W. 106th Street, Cleveland, Ohio.

- ☐ See us about making an Engineering Survey similar to the one you made for Victor Brewery. (No obligation).
- ☐ Send new catalog on Pneumatic Spreader.

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To take up bearings . . . to align or space parts . . . simply peel .002 or .003-inch laminations from the brass Laminum shim. Right at the job . . . no filing, grinding, miking. Speed, accuracy and cost-saving in factory and field service adjustments! ● *Shims cut to your specifications . . . stock shim materials carried by your mill supply distributor.*

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WRITE for file-folder of shim application photos—with Laminum sample.

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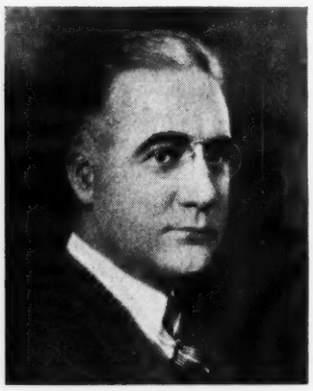
THE SOLID SHIM THAT peels FOR ADJUSTMENT
A-1166

Power Lines

Erie City Iron Works Celebrates 100th Year

The Erie City Iron Works which celebrates its 100th anniversary in July, was the result of the imagination and forethought of Boyd Vincent, who conceived the need for an iron foundry in Erie in 1813. His idea didn't come true, however, until 1840, when he took part in the organization of the Presque Isle Foundry, with the company name of Johnson & Himrod. This company confined its efforts to smelting of ore into iron, and when in 1851 Selden & Bliss started the Erie City Iron Works to make engines, boilers, parts, etc, the two companies worked closely together.

In 1863 the two interests were merged under the name of Erie City Iron Works. Since 1863, the company has continued under the guidance of the Selden family, being changed from a partnership into a



Hays H Clemens

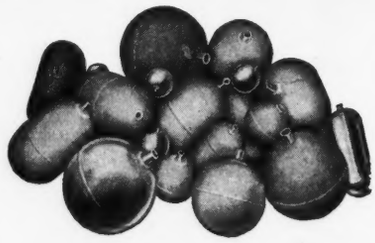
corporation in 1894. George Selden was president from 1863 to 1893, followed by a nephew, George D Selden, who was president until 1922. Hays H Clemens, a son-in-law of George D Selden, was made president in 1925 and is still holding that position.

The original plant was at 12th and State Sts, in the heart of Erie City, the business district, moving later to 14th St and East Ave. In its infancy, the company made everything for the trade such as oil-pumping and ash-handling equipment, portable and stationary boilers used extensively in the oil fields. Later, in the early '80's, it developed a watertube boiler with cast-iron sinusoidal headers, following later with voilers of the steel box-header type. Today, the company makes a wide variety of units to meet modern steam-generating requirements.

Railroads in Hudson County Achieve Smoke Record

Railroads operating in Hudson County, N. J., made an enviable record in eliminating smoke last year, a statement from William G Christy, Smoke Abatement Engineer of Hudson County, says. The

NICHOLSON



HIGH-PRESSURE WELDED FLOATS

Available for all applications—for steam pressures up to 1500 lbs. and hydrostatic pressures up to 2500 lbs.—for corrosive and non-corrosive service.

Made in spherical and elliptical shapes and in sizes from 2½" to 14" diameter. High in tensile strength and offer great resistance to external pressure. Special sizes and shapes available to order, and also cadmium, nickel or copper plated. Fully described in Bulletin No. 339.

OTHER PRODUCTS — NICHOLSON Industrial Steam Traps, Piston and Weight Operated Traps, Flexible Couplings, Expanding Mandrels, Arbor Presses, Compression Shaft Couplings, Steam Eliminators and Separators, Compressed Air Traps.

W. H. NICHOLSON & COMPANY
125 OREGON STREET
WILKES-BARRE PENNSYLVANIA, U.S.A.

Babbitt
Adjustable
SPROCKET RIM
with Chain Guide

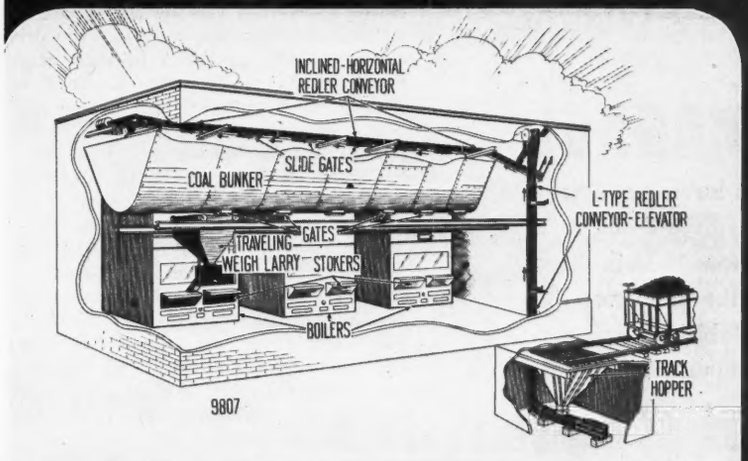
MAKE YOUR OVERHEAD VALVES SAFE and EASY TO REACH—
CONTROL VALVES FROM THE FLOOR

With Babbitt Sprocket Rims on your overhead valves, you can control valves instantly from the floor. Far quicker and safer than climbing ladders.

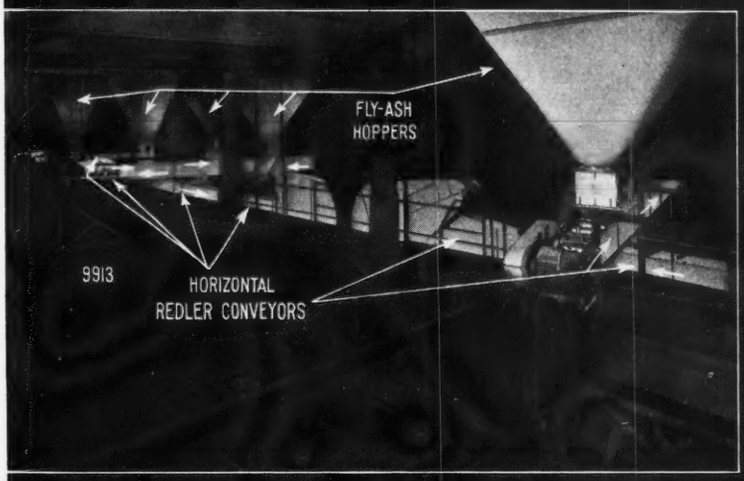
Babbitt Rims are easily attached in a few minutes, are inexpensive and assure safe, positive and instantaneous overhead valve operation. Available for valves of every make or style. Write for details.

BABBITT STEAM SPECIALTY CO.
New Bedford Mass.

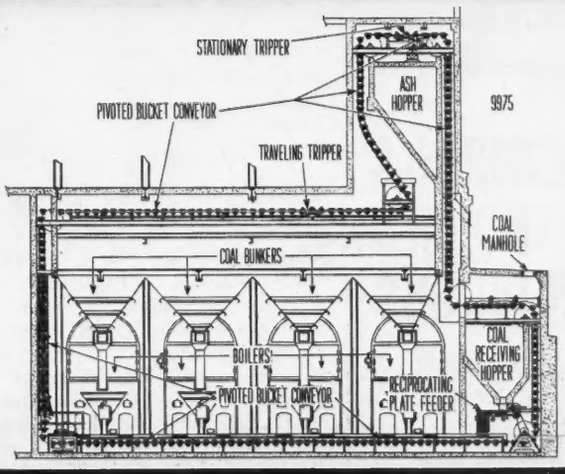
STEPHENS-ADAMSON *Gives You Your Choice of All These Conveyors and Elevators:*



Two Redler Conveyor-Elevators do the entire coal handling job in this Minnesota power plant.



Fly ash is being handled in these Redlers from underneath precipitators to central hopper.



This S-A Pivoted Bucket Carrier has handled over 110,000 tons of coal for a very large eastern hotel.

Being a pioneer manufacturer of all standard types of bulk Material Handling Equipment and exclusive maker of popular Redler Conveyor-Elevators in the U. S. and Canada, Stephens-Adamson is equipped to make accurate, unbiased recommendations on the proper equipment to handle your materials *at the lowest possible cost per ton.*

★ REDLER CONVEYOR-ELEVATORS

Convey and elevate in one unit pulverized, granular, small lump and flaky materials. Operate without Feeders, in little space, in totally enclosed, dust-tight casing. Move coal and fly ash smoothly about bend corners. Eliminate Elevator pits. Quickly, economically erected.

★ PIVOTED BUCKET CARRIERS

Long lived Pivoted Bucket Carriers for moving coal and ash have been engineered and manufactured by S-A for many years. If one of these Conveyors proves to be best for your coal and ash job, S-A is in a position to tell you so, then furnish the job complete.

★ GRAVITY DISCHARGE CONVEYORS

For those certain conditions where Gravity Discharge units prove most economical and are preferred, S-A's experience insures you proper installation and operation.

★ BUCKET ELEVATORS

Bucket Elevators, while to a great extent replaced by Redler Conveyors and Elevators, are still engineered and furnished by S-A when operating conditions warrant.

★ SKIP HOISTS

Skip Hoists are regularly furnished by S-A when *cost per ton figures* prove it advisable.

★ BELT CONVEYORS

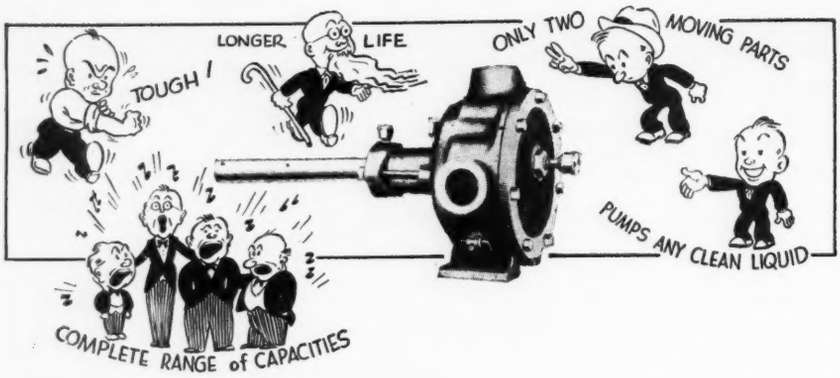
Belt Conveyors are many times the cheapest means of handling coal over a long period. S-A was one of the original makers of this means of conveying and continues to be a leader in their manufacture.

★

HAVE YOU THESE CATALOGS?

Catalogs on any of the above S-A lines will be sent you promptly on request. Information available also on S-A Screening and Transmission lines. ***Write us for catalogs or for recommendations on your Material Handling problems.***

STEPHENS-ADAMSON
MANUFACTURING COMPANY
5 Ridgeway Ave.
Los Angeles, Cal. AURORA, ILL. Belleville, Ont.



ALL Viking Rotary Pumps have just 2 moving parts . . . capacities range from ½ to 1,050 GPM . . . Viking rotates in both directions with like accuracy, like efficiency . . . complete selection of portable and stationary models with special mountings, metals and drive arrangements . . . proper Bulletins with pictures, specifications and installation hints will be hurried back by return mail.

VIKING PUMP CO.
CEDAR FALLS, IOWA

Which Road Would YOU Take?

All of us like to feel that we are getting our money's worth. However, VALUE claims a reasonable price! ★ For sixty-six years Quality has been our first consideration. A few of our outstanding products are

TURBINE OILS • COMPRESSOR OILS
CYLINDER OILS • DYNAMO OILS
DIESEL ENGINE OILS • MOTOR OILS
GREASES
for all purposes

BORNE SCRYMSER COMPANY
ESTABLISHED 1874
17 BATTERY PLACE NEW YORK

report also states, "While the railroads have always been our major problem, they are now making less smoke than any large American community where steam locomotives are used. The records show that, since 1931, there has been an actual reduction of more than 95% in railroad smoke. This is based on 10,396 Ringelmann-chart smoke readings made on locomotive stacks last year by our inspectors.

"The average density of locomotive smoke in 1939, as shown by these more than 10,000 readings, was 0.645%, or slightly more than one-half of one per cent. This compares with 16.03%, the average density during the year 1931. Estimated density of railroad smoke in 1930, before smoke work was started, was 40%.

"In addition to making readings on locomotive stacks, we also make observations of the stacks of roundhouses, where locomotives are serviced at the terminals. 1407 observations were made last year. The total smoke observations on railroads was 11,803. Only 110 of these were violations of the ordinance, or slightly less than one per cent.

"The New York, Ontario & Western Railroad, operating in North Hudson, made the best record of any road, with an average of 0.145% smoke density. The New York Central (West Shore), which operates in North Bergen and Weehawken, N. J. stood second on the list, with an average of 0.226%. Central Railroad of N. J., operating in Jersey City and Bayonne, was third with an average of 0.493%.

"While 110 violations of the Smoke Ordinance may seem a large number, the Hudson County ordinance is strict on railroads. This is an average of only two violations per week. The average weekly observations are more than 200".

NAPE Power Show Scheduled For August

The most comprehensive power show ever conducted by the National Association of Power engineers will be held in Columbus, Ohio, August 19 to 23. Carl R Daubenmire is president of the association which is sponsoring the 39th in a series of shows. This year the show will be held in the Columbus auditorium. The Deschler-Wallick Hotel is convention headquarters and the auditorium is a short distance away.

ASME Spring Meeting

The 1940 Spring Meeting of the ASME will be held May 1, 2, and 3 at the Hotel Bancroft, Worcester, Mass. The three-day convention will feature papers presented by engineers well-known throughout the industry.

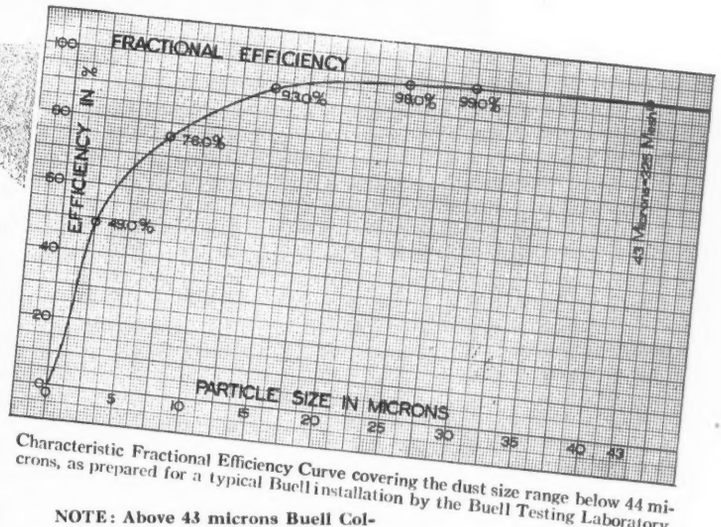
Papers concerning the power field to be given include "Feedwater Treatment", by C H Fellows, The Detroit Edison Co; "Progress of Higher Steam Pressure in the Industrial Plant", by W F Ryan, Stone & Webster Engrg Corp; "Purchase and Use of Fuel", E Wadsworth Stone, Bigelow-Sanford Carpet Co; "Effect of Coal Characteristics on Pulverized-Coal Firing",

OVERALL DUST COLLECTION GUARANTEES *don't mean a thing* unless they are based on PARTICLE SIZE ANALYSIS!

The overall collection efficiency of any mechanical collector for dust of any specific gravity depends on the dust particle size analysis in the all-important range from 0 to 43 microns (sizes that will pass through the finest commercial screens). *Any variation in the particle size analysis* (unavoidable in industrial processes) *changes the overall efficiency.* Thus, "overall efficiency" is never a constant and the term has no real meaning.

Buell, therefore, bases its dust collection guarantees on FRACTIONAL EFFICIENCIES, and guarantees the exact percentage of each micron size of dust that will be collected. This fractional guarantee is both accurate and constant. *It holds regardless of particle size frequency variation.* You know at all times the exact percentage of every size of dust you are collecting.

Buell equipment for dust collection and fly ash correction employs exclusively the world-famous, highly efficient Van Tongeren System —*the only cyclones with a dust pocket.* Investigate Buell and save money!

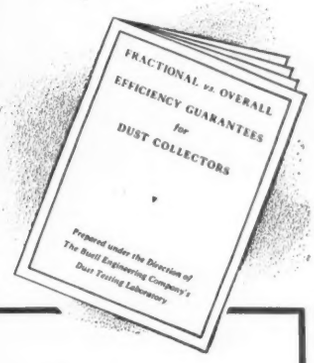


Characteristic Fractional Efficiency Curve covering the dust size range below 44 microns, as prepared for a typical Buell installation by the Buell Testing Laboratory.

NOTE: Above 43 microns Buell Collectors remain at 99.5+% efficiency.

HERE'S THE BOOK THAT TELLS ALL!

Send for "*Fractional vs. Overall Efficiency Guarantees*"—a bulletin of the Buell Testing Laboratory that explains the importance of particle size analysis in determining dust collection guarantees.



buell
DUST COLLECTORS

Only Buell Cyclones have a Dust Pocket

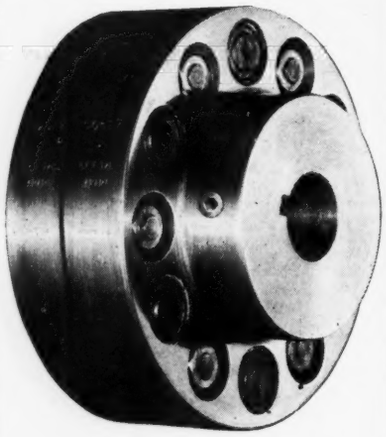
10 CEDAR STREET, NEW YORK

BUELL ENGINEERING COMPANY, INC.

Wherever located, you will be quickly served through sales offices of either BUELL ENGINEERING CO. or B. F. STURTEVANT CO.

AJAX

FLEXIBLE COUPLINGS



NOW

Protect your expensive machines against costly shutdowns with Ajax graphite-bronze, rubber-bushed, flexible couplings. They give you positive drive . . . resilient flexible protection against unavoidable misalignment . . . free end float . . . dielectric insulation . . . no noise, no backlash . . . no lubrication worries . . . dependable performance in dust and abrasive laden air. Cast iron, forged steel, standard and shear pin models. Write for catalog.

AJAX
FLEXIBLE COUPLING CO.
Westfield, N. Y.
132 English St. Incorporated 1920

Sales Offices In:

Atlanta, Boston, Buffalo, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Indianapolis, Kansas City, Los Angeles, Louisville, Milwaukee, Minneapolis, Montreal, New York, Philadelphia, Pittsburgh, San Francisco, St. Louis, Salt Lake City, Seattle, Spokane, Stuttgart, Syracuse

Ollison Craig, Riley Stoker Corp; "Recent Developments in Oil Burning," R C Vroom, Peabody Engrg Corp; "Determination of the Purity of Steam", M C Schwartz, Gulf States Utilities Co; "Some New Types of Materials-Handling Equipment", Russell Hastings, Lewis-Shepard Sales Corp; "Cavitation of Hydraulic Turbine Runners", R E B Sharp, Baldwin-Southwark Div.

The meeting will also include several inspection trips through various plants, including the Norton Co, Rockwood Sprinkler Co, Simonds Saw and Steel Co, Worcester Pressed Steel Co, Leland-Gifford Co, Baldwin-Duckworth Chain Co.

Commonwealth Edison Plans $100,000,000 Expansion

A $100,000,000 plan for expansion of the Commonwealth Edison Co of Chicago, to include the addition of 360,000 kilowatts during 1940, 1941, and 1942, has been announced.

Construction program for 1940 is now under way, and will involve the expenditure of $42,000,000. The two major projects this year are Powerton and Northwest Stations, where 200,000 kw new capacity is being added. In addition, studies are being made which contemplate installations of 147,000 kw capacity at Fisk Station, to be ready in 1942. The 25,000-kw unit for Joliet Station is scheduled for completion by the end of 1941.

At present time, total electric electric generating capacity of the system is 1,866,000 kw. The 360,000 kw to be added includes allowances for service which is to be replaced by new equipment.

The program, according to the company, should provide not only for the estimated growth in system load for next three years, but also necessary reserve.

MEETINGS

American Society of Mechanical Engineers—*Spring Meeting, May 1–3, Worcester, Mass. Semi-Annual Meeting, June 17–21, Milwaukee, Wis. C E Davies, secretary, 29 W 39th St, New York, N. Y.*

American Society of Refrigerating Engineers—*27th Spring Meeting, Skytop, Pa., June 9–11. David L Fiske, secretary, 37 W 39th St, New York, N. Y.*

American Society for Testing Materials—*43rd Annual Meeting, Chalfont-Haddon Hall, Atlantic City, N. J., June 24–28. R E Hess, assistant secretary, 260 S Broad St, Philadelphia, Pa.*

National District Heating Association—*Annual Meeting, May 14–17, 1940, French Lick Springs Hotel, French Lick, Indiana. John F Collins, Jr, secretary-treasurer, 1231 Grant Bldg, Pittsburgh, Pa.*

Heating, Piping and Air Conditioning Contractors National Association—*Annual Convention, May 27–30, Hotel Pennsylvania, New York, N. Y. Joseph C Fitts, Secretary, 1250 Sixth Ave, New York, N. Y.*

Smoke Prevention Association—*Annual Convention, May 21–24, Hotel Statler, St. Louis, Mo. Headquarters Office, City Hall Square Bldg, Chicago, Ill.*

Stoker Manufacturers Association—*Annual Meeting, June 6–7, Homestead Hotel, Hot Springs, Va. Headquarters Office, 307 N Michigan Ave, Chicago, Ill.*

"STANDCO"
PILLOW BLOCKS

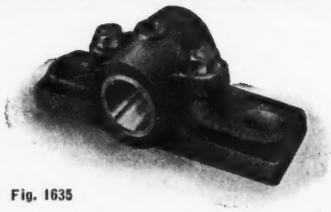


Fig. 1635

Combining clamp block and pillow block requirements in one type, the "Standco" shown above is sturdily built and is offered in a wide range of sizes. Babbitted bearing surfaces are finished beautifully smooth. It can be depended on for long, trouble-free service.

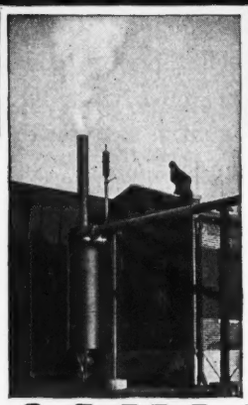
Fig. 32

"Standco" Ball and Socket Pillow Block, Ring or Wick Oiling, Plain or Collar End Babbitted Bearings.

Write for Bulletin

STANDARD
PRESSED STEEL CO.
JENKINTOWN, PENNA.
Boston, Detroit, Indianapolis — Box 577 — Chicago, St. Louis, San Francisco

Silence STEAM EXHAUSTS



Maxim #28 MU1 Silencer on exhaust of Skinner Uniflow Steam Engine.

with

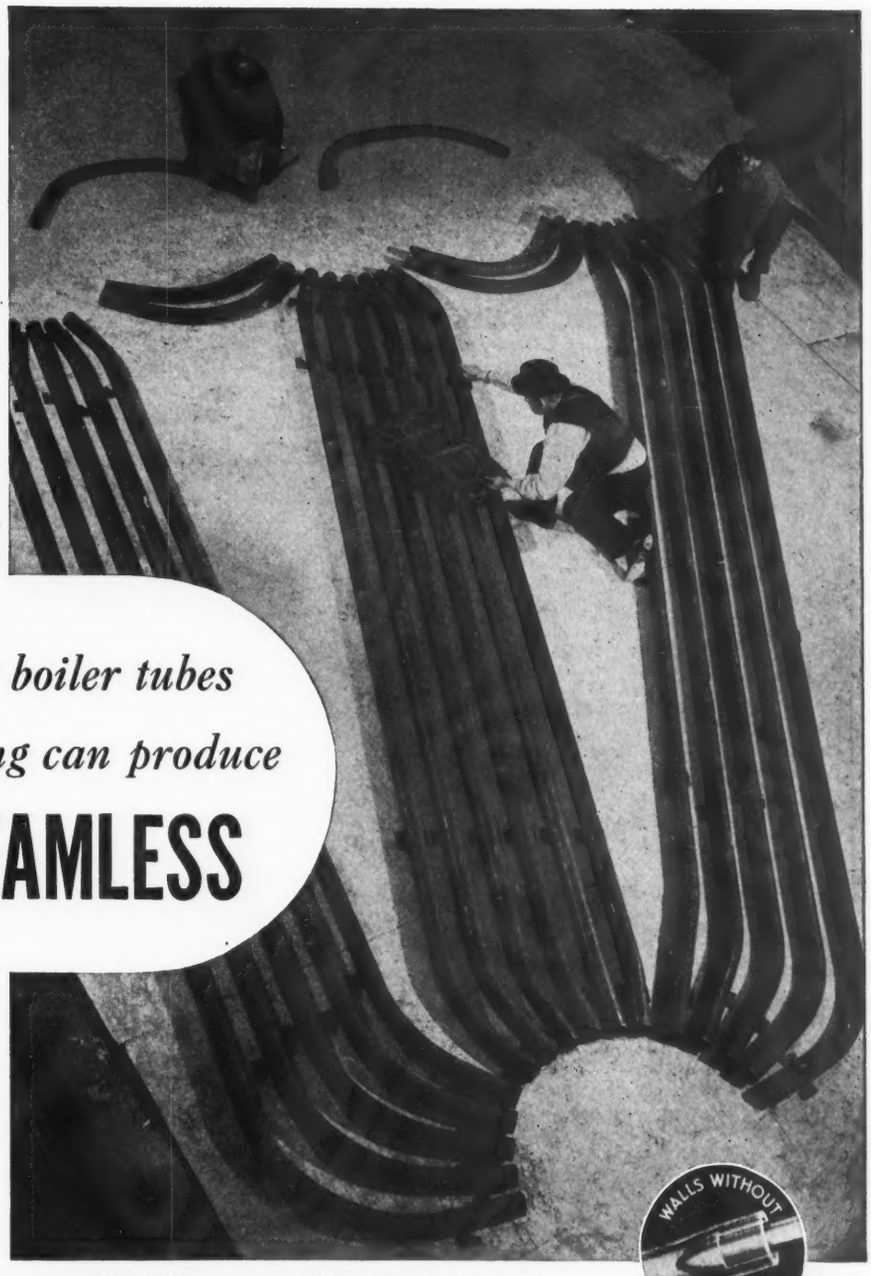
MAXIM
SILENCERS

Steam exhausts present a serious noise-nuisance problem to many industrial organizations—The Maxim installation shown above answered this problem at once for The Glen Alden Coal Co. of Scranton, Pa., and a Maxim engineered installation can do the same for you.

Maxim also makes Silencers for high pressure waste steam discharges, for internal combustion engine exhausts and for air compressors —Write for details.

THE MAXIM SILENCER CO.
92 Homestead Ave. Hartford, Conn.

Bring On Your High Pressures



LAYING OUT a master set of NATIONAL *Seamless Boiler Tubes, before shipment, to assure perfect fit of tubes and easy assembly in a large industrial boiler.* NATIONAL *takes every precaution to make sure that the tubes, when you receive them, are as perfect as modern manufacturing can make them.*

Here are the finest boiler tubes modern manufacturing can produce

NATIONAL SEAMLESS

WHENEVER power engineers get together these days, you hear talk of higher boiler pressures and higher temperatures. The aim, of course, is to take advantage of the better efficiencies obtainable on the upper reaches of the Mollier Diagram.

The high pressure boiler has demonstrated its practicability many times in experimental boilers and within recent years in some industrial boilers operating at pressures as high as 2500 psi and temperatures up to 900°F. Behind this important stride in steam power engineering, and in fact, helping to make it possible, is the seamless boiler tube.

A NATIONAL Seamless Boiler Tube has no weld—no line of potential weakness to limit safe operating pressure. Each tube is a homogeneous steel cylinder, pierced directly from a billet of clean, creep-resisting steel. Every tube is completely annealed before it leaves the mill. Service records in low, medium, and high-pressure boilers prove beyond question that these tubes give longer, safer, and more economical service.

Whether you are building a new high-pressure plant or just retubing an old boiler, you'll find that the safest, strongest tube is the best investment. And that means NATIONAL Seamless Boiler Tubes. Write today for complete information.

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

UNITED STATES STEEL

AN INEXPENSIVE FLOW METER

THE SIMPLEX GYROMETER

When totalizations of boiler feed, condensate, steam and air must be accurately determined specify the GYROMETER.

Designed for use with orifices, nozzles or venturis, the GYROMETER provides an accurate and dependable summary of your flows.

Write for Data

SIMPLEX VALVE & METER CO.
6780 Upland Street
PHILADELPHIA, PA.

OBITUARIES

CHARLES ARTHUR WHITE, 58, secretary-treasurer of Leeds & Northrup Co, died in Philadelphia March 2, following a 2-week illness. Mr White was born near Poughkeepsie, N. Y. From 1902 to 1914 he was associated with Adriance Platt & Co. From 1915 to 1920 he was cost accountant and later purchasing agent of Hero Mfg Co of Philadelphia. He joined Leeds & Northrup as chief accountant in 1920 and in 1928 was appointed secretary-treasurer.

HARRY A RIVERS, 47, president of Boston Pipe & Fittings Co, Cambridge, Mass., died on March 16. He was widely known throughout New England in the heating and ventilating trade.

DENTON K SWARTWOUT, 78, chairman of the Board, Swartwout Co, died suddenly March 22 at his home in Shaker Heights, Ohio. He had been in ill health several years. Mr. Swartwout founded the company about 1901 and served as its president until about 4 years ago. He was a past president of American Supply & Machinery Mfrs Assn. He will be succeeded in the presidency of Swartwout Co by his son, Denton K, Jr.

C R BOGGS, 56, former vice-president of the American Chemical Society and vice-president and general manager of Simplex Wire & Cable Co, Cambridge, Mass., died April 1 at his home. A former president of Mass. Institute of Technology Alumni Assn, he was also a fellow of the Institution of the Rubber Industry of England and American Society for the Advancement of Science.

HUTTON H HALEY, 53, Detroit district sales representative of American Foundry Equipment Co, Misahawaka, Ind., died March 1. He joined the company in 1911, was appointed sales manager in 1926, but resigned a year later to take charge of sales in Detroit territory.

PERSONALS

DAVID W ROBINSON has resigned from the Federal Power Commission, it was announced recently. He had served on the commission since 1939 and is resigning to resume general law practice. William S Youngman has been appointed to fill the position left vacant.

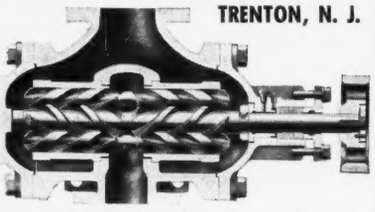
After nearly half a century of continuous service with the Portland General Electric Co, Portland, Ore., ORIN B COLDWELL, vice-president for 24 years, retired March 1 as active vice-president. He will serve in the capacity of a consulting engineer. In his executive career with the company he has been successively electrical engineer, superintendent of Light & Power Dept, general superintendent, vice-president in charge of transportaiton, and vice-president in charge of hydro-electric development and general construction.

DR FRANK W HURD has been appointed to the staff of Chemical Engrg Div, Research Foundation, Armour Institute of Technology. He will work on special fuel-development problems.

So they bought *another* IMO

The pipe line company which owns the portable IMO oil pumping unit here shown recently ordered a duplicate. Other repeat orders just received are fuel oil service, lube oil service and fuel oil transfer pumps for two more Maritime Commission ships, lube oil pumps for a turbine manufacturer, fuel oil service pumps for an oil burner manufacturer, lube oil pumps for a refinery, fuel oil pumps (a total of 18 by ones and twos in six years) for a gas company, etc., etc. De Laval-IMO oil pumps can be run at standard motor and turbine speeds. *Ask for Catalog I-58.*

DE LAVAL STEAM TURBINE CO.
TRENTON, N. J.

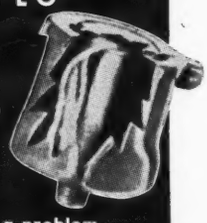


HUNTER

"AIRSPRING" GREASE CUPS

Drawn-steel, cadmium plated .. never known to rust.

"SHURFLO" OIL CUPS



Use them where grit, dust or lint is a problem.

WRITE ON YOUR BUSINESS LETTERHEAD FOR FREE SAMPLE

HUNTER PRESSED STEEL CO.
LANSDALE, PENNSYLVANIA

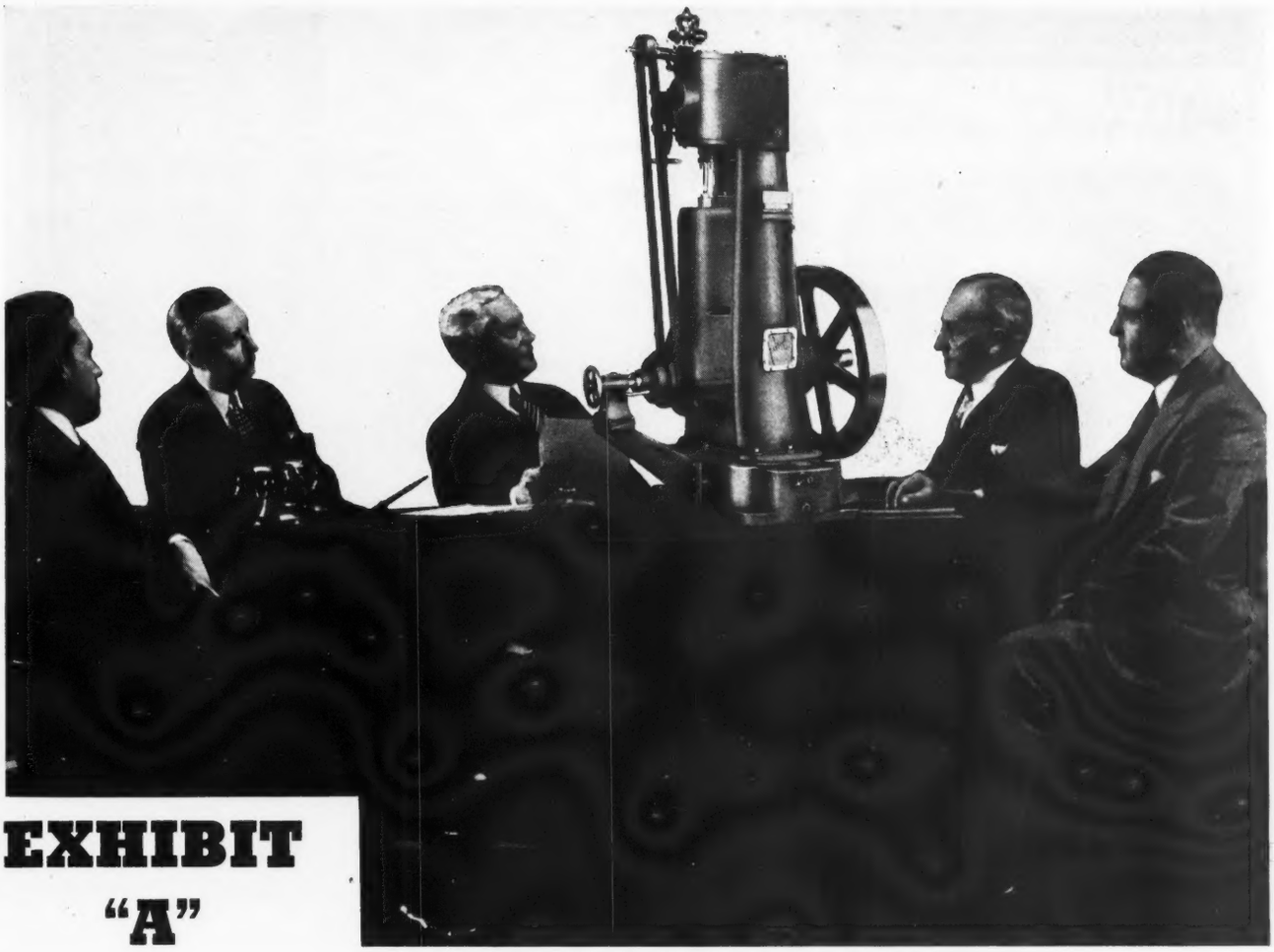


EXHIBIT "A"

A Modern Drive
Big Annual Saving with Low Investment

Let's look at some Troy-Engberg Engine records:

Driven Equipment	Installed Cost of Engine	Annual Saving by Using an Engine	Return on Investment
Ref. Compressor	$755	$789	104%
Stoker	724	576	80%
Ventilating Fan	1160	539	46%
Exhauster	2427	3833	157%
Draft Fan	678	563	83%
Conveyor	512	232	45%

LET YOUR STEAM PAY DIVIDENDS

These excellent annual returns on the entire investment are doubly significant when it is realized that they can be looked forward to for many years. Repairs are so negligible as to have practically no effect on the return There is no lessening of efficiency in a modern steam engine as time goes on.

Note, too, the variety of equipment involved in the case studies listed above. This suggests versatility and mechanical excellence. Why not investigate the merits of this drive for the auxiliary equipment in your plant? You, too, are interested in saving money.

TROY ENGINE AND MACHINE CO.

Established 1870

1461 RAILROAD AVENUE TROY, PA.

PHOTOSWITCH SMOKE ALARM

Increases Fuel Economy — Avoids Smoke Nuisance

WATCH YOUR SMOKE—

THROUGH THIS WINDOW

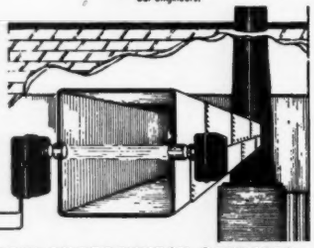
PHOTOSWITCH

The Electric Eye

SMOKE ALARM CUTS FUEL COSTS BY CONTROLLING SMOKE IN THOUSANDS OF POWER PLANTS.

Used by factories, hotels, hospitals, public utilities, institutions, universities, railroads, steamboats, etc. throughout the world.

PHOTOSWITCH INCORPORATED manufactures photoelectric controls and electronic products for all industrial purposes. Refer your electronic control problems to our engineers.



HOW PHOTOSWITCH OPERATES

Photoswitch Control and Light Source are aligned on opposite sides of the flue or breaching, the light beam projecting to the lens of the control. When the smoke passing through the flue exceeds the density at which the tamper-proof sensitivity adjustment has been set, PHOTOSWITCH flashes a signal to boiler room attendant as a warning that combustion conditions require correction.

The PHOTOSWITCH DENSOMETER shown above wired to the output of the control continuously indicates the smoke density and flashes a red signal light when smoke is excessive. Complete smoke alarm installations can be made quickly and easily by your own mechanic.

RUGGED • LOW IN COST • GUARANTEED

FOR VALUABLE INFORMATION ON FUEL ECONOMY MAIL COUPON

PHOTOSWITCH INCORPORATED Cambridge, Massachusetts

Send detailed information on "Fuel Savings with PHOTOSWITCH."

Signed Concern

Address City State

PHOTOSWITCH INCORPORATED

CAMBRIDGE • MASSACHUSETTS

District offices in all principal cities

JAY ARWIN has been appointed Chicago district-manager of Steel & Tube Div, Timken Roller Bearing Co. He became associated with the company in 1937 in the metallurgical department, and since October, 1938, has been a salesman in Chicago branch office.

R R ROBLEY, for many years superintendent of operations for Portland General Electric Co, has been named assistant to the vice-president. He has been with the company since 1904.

HUGH M CORROUGH, recently appointed manager of Alco Products Div, American Locomotive Co, secured his first position in 1923 with Empire Oil & Refining Co at Ponca City, Okla. Continuing in various capacities, he remained until 1934, when moved to Cities Service Oil Co's executive offices in New York City. He has been with American Locomotive since June, 1936, and has served as chief mechanical engineer, assistant manager of engineering, and manager of engineering, which he held up until his present appointment.

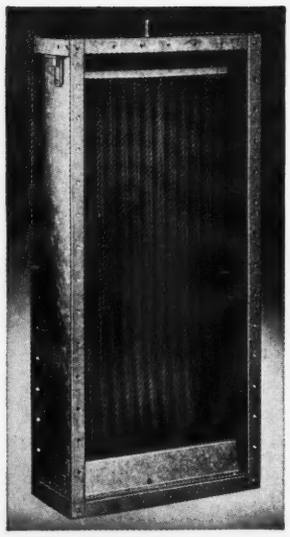
D S KERR has been appointed manager of the Atlanta office of the Allis-Chalmers Mfg Co. A graduate of Purdue University, Mr Kerr entered the apprentice training course in 1922. In 1930 he was made manager of the Chattanooga, Tenn., office. In his new position both Knoxville and Chattanooga offices will be under his jurisdiction.

ERNEST N ROBINSON has been appointed to the newly created position of assistant sales manager of the Accessory Div, Stewart-Warner Corp. Recently district sales representative for the Accessory Div, Mr Robinson has been with the company since 1934.

CHESTER H LANG, manager of General Electric's advertising and sales promotion activities since 1932, has been named manager of apparatus sales and vice-chairman of the Company's Apparatus Sales Committee. The apparatus or capital goods lines range from big turbines to tiny motors.

As advertising manager, and a member of both the Apparatus and Appliance Sales Committees, Mr Lang has been intimately associated with all commercial activities of the company. In 1932 he organized its market research bureau, a section devoted to sales analysis of existing and contemplated products.

Mr Lang, a native of Erie, Pa., and a graduate of the University of Michigan, entered the employ of General Electric as a traveling auditor after service as a first lieutenant in the field artillery overseas with the 35th division. In 1922 he was made assistant manager of the Publicity Department. He continued in this position until 1926, when he was named comptroller of the budget, a position he held until 1932 when he became advertising manager. He also served as General Electric's Manager of Broadcasting with responsibility for operation of its stations, WGY, Schenectady, N. Y.; KGO, Oakland, and KOA, Denver, as well as international broadcasting stations WGEO, WGEA, and KGEI; frequency-modulation station W2XOY, and television station W2XB.



fedders

new type K

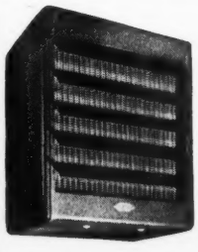
HEATING COILS GIVE HEATING MEN

Design WITH A CAPITAL "D"

Type K Heating Coil features include patented full-floating relief of over-all expansion stresses, and "knee-action" relief of differential expansion between individual tubes . . . spiral fins are pressure wound and metallically bonded on seamless copper tubes . . . entire surface is tinned for protection against corrosion . . . integral orifices and scale breakers . . . generously large cylindrical headers.

Husky, rigid ARMCO ZINCGRIP casings assure adequate protection against piping stresses and coil distortion. Casings are only 9" deep.

Reserve your personal copy of Catalog H-601 right now.



FEDDERS UNIT HEATERS

Built in a complete line from 75 to 1100 EDR.

FEDDERS MFG. CO.

67 Tonawanda St. Buffalo, N. Y.

Air Conditioning Division

*BEST—"excelling all others".

The homogeneous wall structure, a characteristic of tubes made from solid steel by the Seamless piercing process, cannot be *duplicated* nor *effectively simulated* by any other manufacturing process! Hence Seamless Boiler Tubes are perfectly uniform in composition, physical structure and effective strength—absolutely free from zones of potential weakness. Since *only* Seamless can provide all of these essential safety factors it becomes the *one* BEST product for Boiler Tube use! *Pittsburgh* Seamless is manufactured by one organization of tubing specialists, from ore to finished tube. Thus, the dependability of Pittsburgh Seamless Boiler Tubes is controlled to the highest degree. Longer, trouble-free performance in high pressure and high temperature services naturally results.

PITTSBURGH STEEL COMPANY • 1659 GRANT BLDG. • PITTSBURGH, PA.

New York Detroit Chicago Cleveland Houston Los Angeles Tulsa

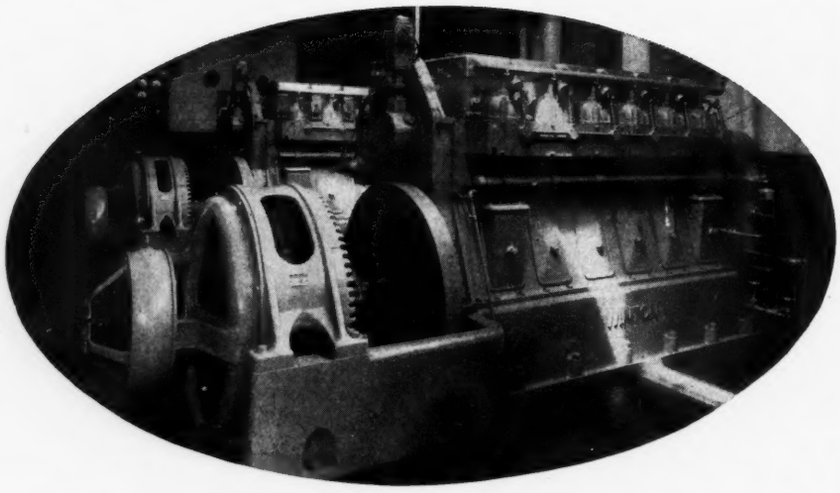
Stocks carried by Distributors in Principal Cities

Pittsburgh Seamless

THERE IS NOTHING EQUAL TO SEAMLESS

BOILER TUBES
POWER PIPING
CONDENSER TUBES
HEAT EXCHANGER TUBES

SERVICE PROVED Lubricants Assure Dependable Performance



Trick oils may look impressive in short demonstrations, but if you want Diesel oils that will give dependable, consistent performance — every day — every week — every month — you will want an oil that has proved its worth. Not an experimental oil but one that has been service proved — a Cities Service oil, engineered for the job.

Experience has shown that no one oil will prove most effective and economical for a given make of engine under all conditions of operation. Such factors as power output, crankcase oil temperatures, etc., may as often as not make the use of a cheap oil expensive and an expensive oil cheap. Let one of our lubrication engineers tell you why — and prove it on your own equipment. Mail the coupon to us or write us on your own letterhead.

In any event you will benefit from reading a copy of our new booklet on "Diesel Engine Lubrication." Sent free to any user of Diesel engine oil.

CITIES SERVICE DIESEL LUBRICANTS

CITIES SERVICE OIL CO.
SIXTY WALL TOWER—Room 1626A,
NEW YORK, N. Y.

Please send me information concerning your Engineers' Lubrication Service (check box) ☐

Please send me folder on "Diesel Engine Lubrication" ..... (check box) ☐

Name _____

Firm Name _____

Address _____ *City* _____

STEPHEN C MAY was made general sales manager of Darling Valve & Mfg Co, Williamsport, Pa., succeeding M L Hough. Mr May was formerly manager of industrial accounts for Iron Fireman Mfg Co and more recently eastern manager for G S Blakleslee & Co.

DAVID R MARVEL, formerly manager of tube sales, Timken Steel & Tube Div, has joined National Tube Co's sales organization as assistant manager of sales, Ellwood Sales Div, Ellwood City, Pa.

S B APPLEBAUM, vice-president and secretary, Permutit Co, New York, N. Y., has been elected a director of that company. He was formerly technical manager before becoming vice-president.

JAMES W COREY, since 1932 general sales manager of Reliance Electric & Engrg Co, Cleveland, was elected sales vice-president at a recent meeting of the board. He started in Engrg Dept in 1911, transferred to Sales Dept in 1916 and in 1927 was made assistant sales manager.

J D FLETCHER, export sales manager, and T R Farley, assistant to the president, have been elected vice-presidents of Caterpillar Tractor Co. Mr Fletcher will continue as head of the Export Dept, the position he has held for the past ten years, while Mr Farley, who is abroad studying export markets at the present time, will retain his administrative duties.

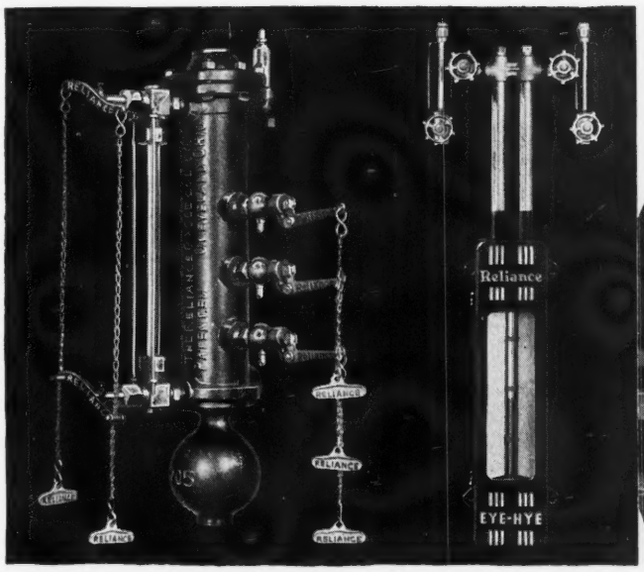
BUSINESS ITEMS

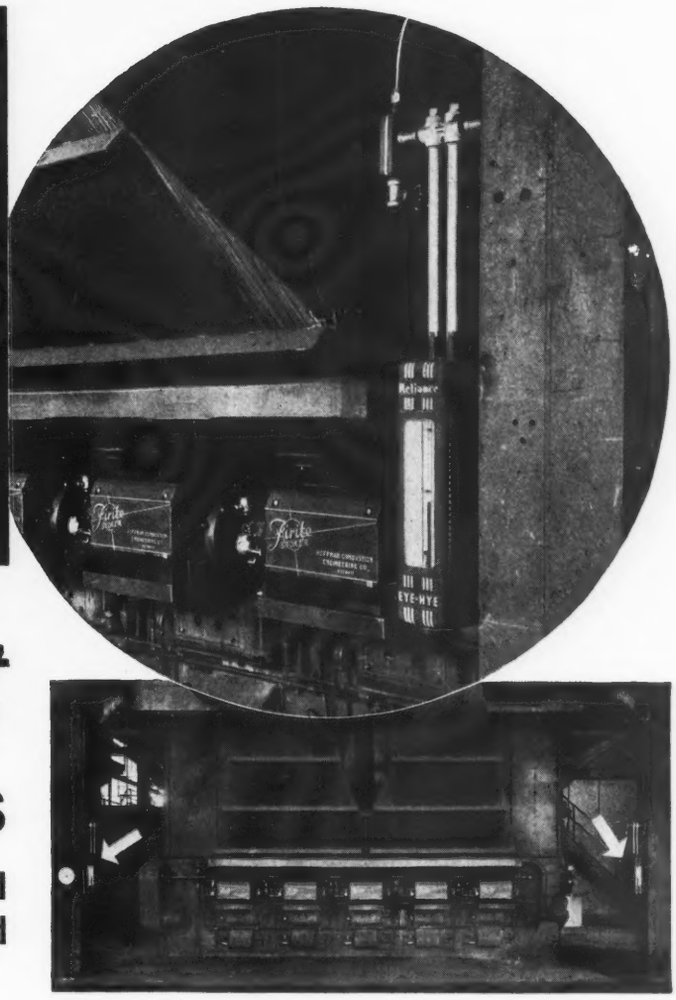
AMERICAN LOCOMOTIVE Co, New York, announces appointment of Duncan W Fraser, William Carter Dickerman, and Robert M McColl, as president, chairman of the board, and vice-president in charge of manufacturing, respectively. Mr. Fraser joined the company in 1904 and up until February of this year was vice-president, director and member of the executive committee. He succeeds Mr Dickerman, who served as president since 1929, and was appointed chairman of the board. Mr McColl was president of Alco Products, Inc, in 1936, when it merged with the American Locomotive Co. At that time he was made vice-president, a position he held up until his most recent appointment.

J-B SALES ENGRG Co, New Haven, Conn., has been appointed Connecticut representative for Worm Gear Div, De Laval Steam Turbine Co. and added Mr Frank Griesing to its staff.

Power Show to Be Held In New York, December 2-7

The 14th National Exposition of Power & Mechanical Engineering will be held December 2–7, 1940, at Grand Central Palace, New York, N. Y. Better known as the Power Show, it brings together the product-displays of over 300 leading manufacturers serving the power field. According to the sponsors of the exposition, 90% of the exhibitors at the last exposition in 1938 have already re-engaged exhibit space. Indications point to the largest National Power Show since 1930.





Get the Most

Out of your Power Dollars

The Reliance Safety Team helps you avoid time-and-money-wasting power breaks caused by water level accidents

The approved modern way to protect your valuable boiler investment is to have *double* water level reading facilities. Reliance ALARM and EYE-HYE supply an outstanding combination of *safety* and *convenience*—guard against any slighting of water level supervision that may result in lost production time and costly accidents.

The ALARM is your *sound* check—warns instantly by whistle when water level goes too low or too high. Extra sturdy, dependable, Reliance ALARMS are standard equipment with many boiler manufacturers.

EYE-HYE brings boiler gages to the operating floor —an easy frequent *sight* check. You can keep water at the most efficient level. Approved by engineers and government bureaus.

Achieve smoother power control and safety that relieves you of water level worries. Put the Reliance Safety Team on your staff and get the most out of your power dollars. Write today for illustrated bulletins.

The Reliance Gauge Column Company
5902 CARNEGIE AVENUE CLEVELAND, OHIO

Reliance TRADE MARK REG. IN U.S. PAT. OFF.

Boiler Safety Devices since 1884

Without climbing or "guessing," operators in this power plant of a large western smelter check water levels in EYE-HYEs conveniently placed at eye level on building pillars. The indicating fluid is bright green, illuminated from the rear. Two small tubes run up to the boiler drum, around girders and pipes.

Five EYE-HYE gages are used in this plant which operates at 210 lbs. W. S. P. Here is a case where a trial of two gages soon resulted in a repeat order for three more EYE-HYEs.

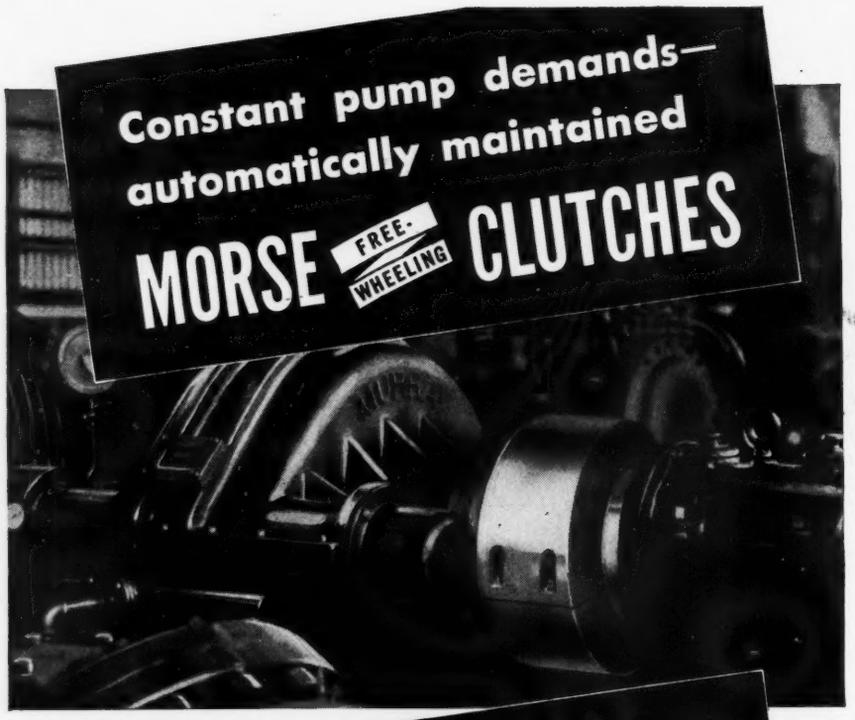
THE RELIANCE GAUGE COLUMN CO.
5902 Carnegie Ave., Cleveland, Ohio

Please send bulletins describing the Reliance Safety Team—ALARM and EYE-HYE.

Name_____

Company_____

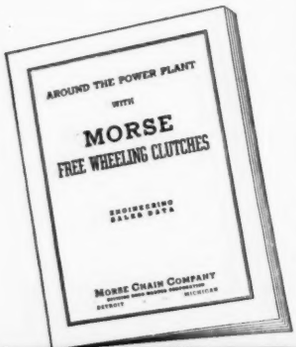
Address_____



Because of the operating features of Morse Free Wheeling Clutches, constant pump speed is automatically maintained in this important central pumping station. Should steam pressure fall in the turbine, a motor cuts in automatically to make up the power deficiency and keep the pump operating at regular capacity.

In normal operation—with one driver working—the opposite Morse Clutch free wheels and the idle driver does not turn. Yet the idle driver may become the driving unit instantly upon need.

Morse Clutch-equipped dual drives are more economical, and more efficient. No power is wasted. There's no danger of damaging turbine rotor or motor windings. Cumbersome cut-out couplings are unnecessary. Morse Free Wheeling Clutches are dependable, capable of years of the most exacting service.



Send for Clutch Engineering Bulletin

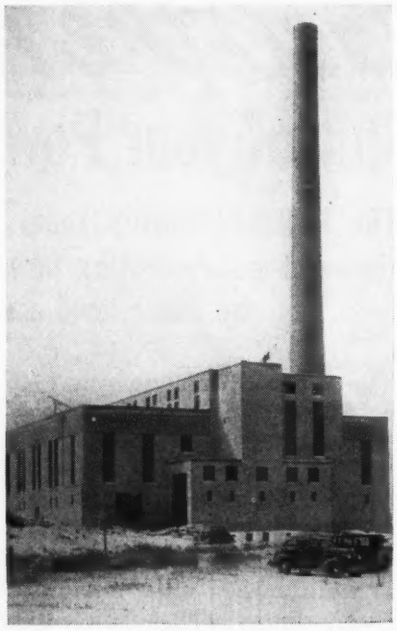
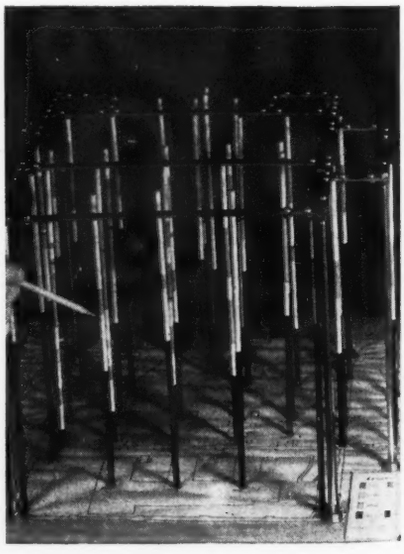
"Around the Power Plant with Morse Free-Wheeling Clutches" contains helpful, practical data you should have—interesting diagrams of typical power plant applications. Write for your copy today!

SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS KELPO CLUTCHES

MORSE *positive* DRIVES

MORSE CHAIN COMPANY, ITHACA, N. Y. • DIVISION BORG-WARNER CORP.

MODEL OF THINGS UNSEEN

In planning the foundation for the new power plant of the Whitehill, Pa., School for Boys, now nearing completion, the consulting engineers, R A Langworthy, Inc, found it necessary to visualize the sub-surface conditions, revealed by $3,000 spent in core borings. Mr Langworthy built a scale model of the drillings (see below), using wooden dowel rods correctly spotted on the foundation plan to represent the cores. Each rod is banded with colors representing the various strata. Brass frame work at top is a scale representation of the foundation plan at ground level.

The Whitehill plant stands on a limestone formation containing many cavities. Carrying the foundation to "solid rock" was not sufficient, because the excavation may stop only a few inches above a large cavity in the limestone. Study of this model has prevented such errors, and has insured a safe foundation design.